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THE  
PHILOSOPHY  
OF  
EARTHQUAKES,  
NATURAL and RELIGIOUS.  
OR  
An Inquiry into their Cause, and their  
Purpose.

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*O Vitæ philosophia dux, virtutum indagatrix, expul-  
trixque vitii!* CICERO.

---

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Rector of St. George's, Queen-Square; Fellow  
of the College of Physicians, and of the Royal  
and Antiquarian Societies.

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PHILOSOPHY

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EARLY THOUGHTS

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[Price Two Shillings]



To the READER.

**T**HE substance of the philosophical part of this discourse was delivered at twice to the Royal Society, on March 15, and 22: The theological, in my own church. I could not refuse the solicitation of my friends, bearers in both places, to print it. I wish my intention, in the compliance, may any ways prove successful; to show, how vain, and unmeaning, are all our philosophical inquiries, when destitute of their true view; to lead us into the more engaging paths of religion. That, from speculation of material Causes, we may become adepts in that wisdom which is from above. Otherwise, like Epicurus, and the ancient heathen philosophers, we barter away our immortal part, for a curiosity, that amuses us to no good purpose. Mean are these objects of our

A 2                      senses

## TO the READER.

*senses to be accounted, in comparison of our spiritual natures, to which our principal regard is due ! For we must rightly say with Job : Lo, these are parts of God's ways, but how little a portion is heard of him ? and the thunder of his power, who can understand ?*



TO

T O

*Martin Folkes, Esq; L L. D.*

President of the Royal Society.

March 26, 1750.

**W**HEN so great and unusual a *phæno-*  
*menon*, as an earthquake, and that  
 repeated, happens among us; it  
 will naturally excite a serious reflexion in every  
 one that is capable of thinking. And we  
 cannot help considering it, both in a philoso-  
 phical, and a religious view. Any mind will  
 take the alarm, when we perceive a motion  
 that affects the earth, that bears the whole city  
 of *London*, and some miles round it. And at  
 the same time while it gives us so sensible a  
 shake, so gently sets us down again; without  
 damage to any buildings, and without a life lost.

'Tis hard to say, which is the greater won-  
 der. But alas! in the works of nature, there  
 are no degrees of great, and little; comparisons  
 are incompatible. We indeed are more affec-  
 ted with what seems great in our own appre-



hensions: I would rather say, what is rare and unusual. An omnipotent power admits of no distinctions. And when prodigious effects are produced from causes imperceptible, it rightly claims our most serious attention, as well as wonder. Nor need we lose sight of the theological purpose of these amazing alarms; whilst we endeavour to find out the philosophy of them.

Among all the appearances of nature, which are the subject of the inquiries of the Royal Society, none more deserves the regard of a contemplative mind. And among the very numerous accounts received there, from all quarters, being only Observations upon the manner of it, and its extent: I judged, it became us to inquire into the *cause* of so extraordinary a motion: of which we could not form a proper idea; had we not repeatedly seen, and felt it.

The moderns have not improved upon the opinions of the ancients, in this matter; any further than by the fancied analogy of some chymical experiments. But these chymical experiments, and all sorts of explosions by gunpowder, and the like, are to me a very unsatisfactory solution; they are merely artificial Compositions, which can have nothing similar in the bowels of the earth, and they produce their

their effects by violence, by rending and tearing, by a *solutio continui*. This is indeed too often the case of earthquakes, but that in a partial degree, not at all equivalent to the compass of the shock; and is very far from being the constant concomitant of an earthquake. Quite the contrary. Innumerable such happen, when there is no breach of the surface; and of these three or four which we have now felt, nothing of it has appeared. But the immensity of the vibration of the earth which shook every house in *London*, with impunity, and for twenty miles round, can never, in my apprehension, be owing to so unbridled a cause, as any subterraneous vapours, fermentations, rarefactions, and the like; the vulgar solution. Nor does the kind of motion, which I discern in an earthquake, in any sort agree with what we should expect from explosions.

In order then to proceed with some degree of certainty, in our enquiry after the cause of earthquakes, it will be useful, in the first place, to set in one view, the general appearances remarkable therein; the most usual concomitants: As we can collect them from our own observation, or from the relations and writings of others.

## CIRCUMSTANCES.

I. That earthquakes always happen in calm seasons, in warm, dry, sultry weather; or after a dry, frosty air.

II. That they are felt at sea, as well as land, even in the main ocean; and at that time, the sea is calm.

III. That earthquakes differ very much in magnitude. Some shake a very large tract of country, at the same instant of time; nay, sometime extend to very many countries, separated by mountains, seas, lakes, the ocean

IV. That earthquakes differ very much in the quantity, of their vibratory motion: Whence in some, tho' largely extended, they are innocuous; in others, both small and great, they lay all in ruin and destruction.

V. That a hollow, thundering, unusual noise accompanies them, or rather seems to precede the shock; which rolls in the air like the noise of cannon.

VI. That they are felt more sensibly in the upper story of houses than in the lower.

VII. That the shock is more violent upon more solid buildings, churches, castles, and stone-houses, than upon those of slighter materials.

VIII. That



VIII. That many people find themselves sick at stomach, with headake, and pains in their joints, and the like, which sometime lasts for the day after, or longer.

IX. That earthquakes generally happen to great towns, and cities, and more particularly to those that are situate on the sea.

X. That earthquakes do not cause any damage to springs and fountains; but the water in wells becomes foul for a short time.

XI. That they are more frequent in the neighbouring countries of a vulcano.

This last circumstance, in my opinion, has led all inquirers in this question, out of the true path; therefore I propose in the ensuing paper,

I. To shew what it is not; the insufficiency of the vulgar opinion, of subterraneous fires and vapours.

II. To show what it is in reality, as it appears to me.

III. I shall conclude with the moral use we ought to make of these prodigies of nature.

I. The struggles of subterraneous winds and fires, that should heave up the ground like animal convulsions, seem to me impossible: Their powers, and manner of acting (if such there be) is quite incapable of producing the appearance of an earthquake. That these should  
operate

operate instantaneously, in one minute, thro' a circle of 30 or 40 miles diameter, or more, I could not conceive. Nor that there should be any possible, much less ready passage thro' the solid earth, for such nimble agents, as every one is apt to imagine, that speak of this appearance ; without sufficiently reflecting on the insuperable difficulties in that *hypothesis*.

We cannot pretend to deny, that there may be such vapours, and fermentations, inflammable substances, and actual fires, in the bowels of the earth ; and that there may be some caverns under ground, as well as we find some few above ground : such as *Pool's-Hole*, *The Devil's-Arse in the Peak of Derbyshire*, and *Okey-Hole in Somersetshire*. These, I believe, to have been so from the creation, never were made by earthquakes. We know, there are hot springs running continually : There are some vulcano's frequently belching out flames and smoke, and to these perhaps some earthquakes may be owing, tho' not according to the vulgar notion ; as we shall see, by and by.

But these matters are very rare, much rarer than earthquakes, both as to time and place. *Vesuvius* in *Italy*, and in that part of it abounding with mines of sulphur : *Ætna* in *Sicily*, and *Heckla* in *Iceland* ; these are all we know of, in the old world. In the *Andes* mountains

of

of *America* there are some. The scarcity of these appears to me a strong argument against the common deductions made therefrom, as to their being the cause of earthquakes.

Nor can I enter into the sentiments of those that hold the cavernous state of the earth, so as to contribute to the forming an earthquake by vapours running from place to place under ground. How many thousand acres of coal-mines do they daily work in *England*, and have done for ages? I have been myself 2 or 300 feet deep in a solid rock of native salt: I have walked a mile lengthwise directly into the earth, and descending all the way, in the proportion of one yard in five, 'till we came under the bed of the very ocean, where ships were sailing over our heads. This was at Sir *James Lowther's* coal-pit, at *Whitehaven*. We were at this time deeper under ground by the perpendicular, than any part of the ocean, between *England* and *Ireland*.

We never hear, from the many hundreds of thousands of workmen in this kind, at *Newcastle*, *Nottinghamshire*, *Yorkshire*, *Derbyshire*, *Staffordshire*, *Somersetshire*, and *Wales*: from the infinite numbers of workmen in the mines of lead, tin, and the like, of the cavernous state of the earth, so as to give any colour for this hypothesis of earthquakes. The earth is generally



rally of solid rock ; in which there must be now, and then, some clefts, and vacuities, small in compass, as naturally so many heterogeneous *strata* of the earth consolidate together. But there can be no imagination of vapours breaking through, uniting, traversing so suddenly, a large space of earth, so as to produce those earthquakes, we have seen, and felt ; much less such as we read of. The workmen in all sorts of mines confess by their hard labour, that the earth is not cavernous ; nor are there mines of sulphur, nitre, and the like inflammable materials in *England*. Or if there were, could they burn, and cause convulsions of the earth, without proper cavities, pipes, and conveyances of air ; as vulcano's, and coal-pits, when set on fire. But even from these coal-pits, when fired, do we ever find any thing like an earthquake produced. Nor do we find earthquakes frequent in those countries, that abound with coal-mines, as certainly would be the case, if that *hypothesis* was just. How easy would it be, on the slightest occasion for earthquakes to happen in the countries abounding with coal-mines, which are so full of artificial cavities communicating with one another, for many miles together : The very thing supposed, by those who hold the old opinion, of vapours traversing the earth for that purpose.

In

In the coal-pits, some small natural cavities now and then are found; which when opened, send forth a pestiferous vapour, and a fire-damp which runs for a long time together. And tho' there are many substances that may generate air, within the bowels of the earth; yet these matters are infinitely unable to produce an earthquake: Never would have force to open a passage for themselves thro' the solid rock, of perhaps many hundred feet in thickness. Nor did we observe in these last earthquakes any fire, vapour, smoke, or smell, any kind of eruption, in the least; as must certainly have been, in so great a struggle of the surface, as affected a circle of so large a diameter. Were there such, we could scarce hope any otherwise, than that they would be too sensibly felt; to the destruction of many thousands, by their pestiferous qualities.

Indeed this consideration alone, of the extent of that surface, is sufficient to overthrow any supposition, of earthquakes being chiefly owing to subterraneous vapours: They cannot momentarily fly under so large a tract of ground, if they were near the outward shell of the earth. They could not do it without breaking ground, and discovering themselves to the sight, or smell; and that for a long time after. It cannot possibly be imagin'd, they should have so immense a force, as to lift up the city of *London*,  
and

and never be perceived by our organs, and outward senses. We have frequent accounts of a little fire-ball bursting in the air, at a distance; yet it instantly propagates a sulphureous smell around.

If the movement of a superficies of 30 miles diameter was owing to fumes, and vapours; we ought reasonably to find some great discharges of them, belching out smoke and fire, for a long time after like vulcano's, and coal-pits fired. The operation of the shock ought to be of hours continuance, not instantaneous; and the evaporation of so vast a quantity of matter, must darken the whole region of the air for a long time after; or require a long time, if gradually it discharges itself. We see how immense a volume of smoke is produc'd by a very small quantity of gun-powder; and no vapour could be so subtle, that produc'd such effects, and not be very obvious to our senses.

Even in vulcano's, it is the opinion of the learned *Italian* philosopher *Borelli*, and of other great naturalists, that they are kindled first from the surface, where there is a possibility of ventilation from the air. They imagine, it begins at the top of the mountains; not by any fancied fermentation of the *pyrites* and sulphureous vapours



vapours arising from subterraneous caverns, in the lower parts of mountains.

There is another consideration, which utterly overthrows these suppositions, of earthquakes being caused by any thing under-ground; and that is a due consideration of springs, and fountains perpetually flowing; and that from the creation of the world to this day. If we would form any tolerable idea of their nature, we must needs conceive, that God Almighty has laid their pipes, and canals in the earth, from a great depth, even to the surface; like as he has planted the veins, arteries, and glands in an animal body. And likewise that they are more and more ramify'd, as they nearer approach the outward shell of the earth; just so our veins, and arteries, as they come nearer the skin.

The workmen in coal-mines, and those of metals, minerals, and stone-quarries, never fail to meet with springs, and currents of water, every where. Often they ruin, and divert springs another way, only by digging into the earth for foxes, and the like. Whenever they dig for wells, in any kind of earth, they commonly find springs. The colliers, and workers of mines, are oblig'd to drain the waters off with very great Expence.

These are circumstances not favorable to subterraneous fires being in the earth in abundance;

dance; much less to their being the cause of earthquakes. And further, we cannot possibly think of earthquakes doing their work that way, without absolutely ruining the whole system of springs, and fountains, throughout the whole country, where they pass. But all this is quite contrary to fact; even where an earthquake has been repeatedly. For an instance from home:

On *Wednesday, April 6, 1580*, about six in the evening, just such another earthquake was felt in *London* and around it, as these two we have seen. Another exactly similar 1692. In all these four, no houses thrown down, no springs disturb'd thereby, no sensible eruptions nor smells.

These considerations I apply only to this little inconsiderable space, of a circle 30 miles diameter; as with us. But what is that to the earthquakes we read of in history? In the year of our Lord 17, no less than thirteen great and noble cities in *Asia minor*, were destroyed in one night. *Tacitus, Pliny*, and many other authors mention it. The fact is so notorious, that some Persons here present, have seen a vast block of white marble now standing near *Naples*; being the pedestal of a coloss statue of *Tiberius* the emperor; having carv'd on it the *genius's*, or pictures of all those cities, with  
their

their names. The accurate *Bulifon* and others have wrote treatises upon it. These cities were rebuilt by that emperor. But without going so far, we may see another evidence of it, a coin of that emperor struck upon the occasion, with this inscription,

## CIVITATIBUS ASIAE RESTITUTIS.

I have one of them, in large brass, which was found at *Colchester*.

The compass of this earthquake may be reckon'd to take up 300 miles diameter, as a circle. Now, we cannot conceive, how any subterraneous vapour can produce such an effect, as instantaneously to demolish all these cities; and that such an accident should never happen after. That the whole country of *Asia minor* should not at the same time be destroy'd, its mountains be renversed, its fountains, springs, and rivers broken up and ruin'd for ever. Instead whereof we find nothing suffered, but those cities; no kind of alteration in the surface of the country; it remains the same as it were in the beginning of time. In 1586 an earthquake in *Peru*, that extended 900 miles.

From these considerations, I cannot persuade myself, to enter into the opinion of vapours, and eruptions being the cause sought for; and,

B

after



after we have treated the argument in a superficial view, we must go a little deeper.

If we would consider things like philosophers, let us propose to ourselves this problem: Where is the power to be plac'd, that is requir'd to move a surface of earth 30 miles in diameter?

To answer this, consult the engineers, and those that make mines in the sieges of towns; they will acquaint us, that the effect of mines is produced in form of an inverted cone. And that a diameter of 30 miles, in the base, will require an *axis* of 15 or 20 miles to operate upon that base, so as to shake it, at least. Now the vapours, or whatever power we propose to operate, according to the foregoing requisite, in order to form the appearance of an earthquake, must be 15 or 20 miles deep in the earth. But what mind can conceive, that any natural power is able to move an inverted cone of solid earth, whose base is 30 miles diameter, whose axis 20? or was it possible; would not the whole texture of that body of earth be quite disturb'd and shatter'd, especially in regard to its springs and fountains? but nothing like this is ever found to be the consequence of an earthquake, though fatal to cities.

Apply

Apply this reasoning to the earthquake of *Asia minor*, and this vigorous principle at the *apex* of the cone must lie, at least, 200 Miles deep in the ground. Enough to show the absurdity of any moving power placed under the Earth! A cone of 300 miles diameter at base, 200 miles *axis*: I dare be bold to say, that all the gun-powder made since its invention, if put together and fired, would not be able to move it; how much less pent up vapours? what must we say of a circle of 600 miles diameter?

But, could that be admitted as possible, would any one be persuaded, that such a subterraneous tumult, of so vast an extent, will be no ways injurious to the internal system of springs and fountains, and that this shall often be repeated without the least damage? We may as well imagine, that we can stab a man 100 times and never touch vein or artery.

Since I gave in my two papers to the Royal Society, a letter of Mr. *Flamsted's* has been printed, which abundantly confirms my sentiments. The whole drift of it is, to show how invalid is the vulgar idea conceiv'd, of earthquakes arising from subterraneous vapours and eruptions: That the earth itself is not moved to any depth, and that the shock must arise from the atmosphere. The circumstances

which he has judiciously collected, are extremely agreeable to mine ; many of them the very same, strongly confirming my *hypothesis* : And had that great man known the properties of electricity, which we are now masters of, he would have prevented me in this affair.

“ Considering (says he) what variety of  
“ substances, sand, gravel, stones, rock, minerals, clay, and mold, our earth is compounded of, and how little nitre, or explosive matter, a large quantity thereof will afford ; I cannot think, where we can find matter enough to move so vast a bulk of earth, as all the South parts of *England*, all the *Netherlands*, with part of *Germany*, all *France*, and perhaps *Italy*, (which were shock'd at once the 8th of *September* last 1692) ; or part of *Asia*, and near all *Europe*, which trembled together the same day, 91 years before.

“ But, allowing there may have been sufficient matter prepared for these purposes, I can hardly think, there are continued cavities, at any reasonable depth, all under *Europe*, wherein an explosion being made, might shake the whole at once, and yet make no clefts, or separations, in those parts where the minerals and mountainous rocks part from the light mold and clay.

“ If



“ If an hundred barrels of gun-powder could  
“ be fixed in some cave, a thousand yards un-  
“ der ground ; allowing the force of the ex-  
“ plosion sufficient to raise all the weight of  
“ earth incumbent on the cavern ; it would  
“ certainly break the loose mold from any  
“ large solid rock we may conceive adjacent,  
“ and leave at least some clefts behind it.  
“ But we seldom or never hear of such clefts,  
“ made in such places, when earthquakes  
“ happen.”

Again, he writes thus : “ I cannot appre-  
“ hend, (if all earthquakes must be made by  
“ explosions in subterraneous caverns) why  
“ sometimes a large country, or whole con-  
“ tinent, should be thereby shook all at once ;  
“ why there should be no eruptions in the  
“ neighbourhood ?”

From all circumstances considered, he con-  
cludes, that the abstruse, effective cause of  
them comes from the air ; and that a calm is  
necessary before an earthquake. And these  
two particulars are likewise Dr. *Hales's* posi-  
tions : “ The earth-lightning, as he calls it,  
“ is first kindled on the surface, and not at  
“ great depths, as has been thought ; whose  
“ explosion is the immediate cause of an earth-  
“ quake. He says, long, dry, hot seasons,  
“ are usually the preparatory forerunners of

"earthquakes." From all these considerations I conclude ; earthquakes are not caus'd by subterraneous vapours.

II. We are to inquire, what is the cause of earthquakes.

In an age when electricity has been so much our entertainment, and our amazement ; when we are become so well acquainted with its stupendous powers and properties, its velocity, and instantaneous operation through any given distance ; when we see, upon a touch, or an approach, between a non-electric and an electrified body, what a wonderful vibration is produc'd ! what a snap it gives ! how an innocuous flame breaks forth ! how violent a shock ! Is it to be wonder'd at, that hither we turn our thoughts, for the solution of the prodigious appearance of an earthquake ?

Here is at once an assemblage of all those properties and circumstances which we so often see in courses of electricity. Electricity may be call'd a sort of soul to matter, thought to be an ethereal fire pervading all things ; and acting instantaneously, where, and as far as it is excited. 'Tis every body's observation, that there never was a winter, like the last past, in any one's memory, so extremely remarkable for warmth and dryness, abounding with thunder and lightning, very uncommon in winter ;

winter ; coruscations in the air frequent, justly thought electrical by all philosophers ; particularly, twice we had the extraordinary appearance of that called *aurora australis*, with colours altogether unusual ; and this just before the first earthquake : All the while the wind constantly south and south-west, and that without rain, which is unusual with these winds.

This state of the atmosphere had continued five months before the first earthquake. Is it not hence reasonable to conclude, that the earth, especially in our region, must be brought into an unusual state of electricity ; into that vibratory condition wherein electricity consists ; and, consequently, nothing was wanting but the approach of a non-electric body, to produce that snap, and that shock, which we call an earthquake ; a vibration of the superficies of the earth.

That the earth was in that vibratory and electric state we have further reason to conclude, from the very extraordinary forwardness of all the vegetable world with us. Every one knows, that, at the end of *February*, all sorts of garden-stuffs, trees, fruits, and flowers, were as forward as in other years, by the middle of *April*. Conformable to which, experiments abundantly show, that electrifying of



plants quickens their growth, equally as in animals it quickens the pulse. Nor will the unusual driness and warmth of the weather solely account for such a precipitate vegetation : because a necessary supply of rain was wanting, as in the natural spring-season.

A very long dry frost will produce the same electrical state of the earth, as it equally favours electrical experiments. Thus, *March 27, 1076*, a frost from the 1st of *November* to the middle of *April*, a general earthquake in *England* succeeded. *Matt. Paris.* That of *Oxford*, 17th of *September 1683*, was after a frost. *Jan. 4, 1680*, An earthquake in *Somersetshire* : The air was very calm ; a frosty night.

Mr. *Flamsted* concurs with us, in our first position, That earthquakes always happen in *calm* seasons. He adds, “ That *Keckerman*, “ a learned author, who wrote on the subject, “ affirms, and backs it from the authority of “ *Aristotle* and *Pliny*.”

The 8th of *September 1601* was a very calm day but cloudy : And the *Smyrna* merchants observe the earthquakes there happen in calm, still weather. The remarkable clearness and calmness of the morning was observed in that of *Oxford 17th of September 1683*, and the air continued so for five or six days after : There-  
fore

fore we may infer, that it is not impossible, what has been abundantly related, that some foreigners from *Italy* here in *England*, some from the *West-Indies* (in both which countries earthquakes are more frequent than with us) did seem to apprehend our first earthquake, from the apparent temper of the weather; and observations of this kind are as old as *Aristotle*. It is observed in *Jamaica*, when the air is extraordinary calm, an earthquake is always apprehended.

We had lately read at the Royal Society, a very curious discourse, from Mr. *Franklin* of *Philadelphia*, concerning thundergusts, lightning, the northern lights, and like meteors. All which he rightly solves from the doctrine of electricity. For, if a cloud raised from the sea, which is a non-electric, happens to touch a cloud raised from exhalations of the land, when electrified, it must immediately cause thunder and lightning. The electrical fire flowing from the touch of perhaps a thousand miles compass of clouds, makes that appearance which we call lightning. The snap which we hear in our electrical experiments, when re-echoed from cloud to cloud, the extent of the firmament, makes that affrightning sound of thunder.

From

From the same principle I infer, that, if a non-electric cloud discharges its contents upon any part of the earth, when in a high electrified state, an earthquake must necessarily ensue. The snap made upon the contact of many miles compass of solid earth, is that horrible uncouth noise; which we hear upon an earthquake; and the shock is the earthquake itself.

In the relation received from *Portsmouth*, and the *Isle of Wight*, concerning the last shock there, on the 18th of *March*, the writer observes, the Day was warm and serene, but, upon a gentle shower falling in the evening, the earthquake came. Here we have reason to apprehend the electrified state of the earth, and the touch of the non-electric; which caused the earthquake.

The learned Dr. *Childrey* observes, treating on this subject, that earthquakes happen upon rain; a sudden shower of rain in the time of a great drought.

'Tis objected, that, if this was the case, nothing would be more frequent than earthquakes; but these two circumstances concurring, a shower and dry weather, must not necessarily cause it, any more than touching a tube before it is electrified causes a snap. The earth must be in a proper electrified state to produce



produce it ; and electricity has its fits ; is remitted, intended, ceased and recommenced. It has its bounds. All causes must concur. And now, with us, all necessary causes did so apparently. Tho' a shower of rain falling upon the earth when electrified, may cause an earthquake, yet too much rain before, will prevent that state of electricity necessary.

The day before the catastrophe of *Port-Royal*, the weather was remarkably serene and clear. In that most dreadful earthquake, 1692, of *Sicily*, where 54 cities and towns, beside a great number of villages were destroy'd ; but especially the whole city of *Catania* : It was preceded by a most agreeable, serene and warm season, which was the more observable on account of its being unusual at that time of the year.

I have been inform'd, that in the morning of both earthquakes last past with us, the air was serene and calm ; on the morning before that 8th of *February*, the air was observ'd to be remarkably calm ; and that a little before, a black cloud appear'd over great part of the horizon. Dr. *Hales*, in his relation, says, the Centinels in *St. James's Park*, and others who were abroad in the morning of the last earthquake, observ'd a large black cloud, and some coruscations, just before the shock, and that it  
was

was very calm weather : And that, in the history of earthquakes, they generally begin in calm weather, with a black cloud.

This observation precludes the suspicion of earthquakes arising from tumults and commotions in the upper, or under region of the air. The remarkable clearness of the air before earthquakes, observ'd by all, shows evidently how free it is from vapours and the like.

Agreeable to our *fifth* position, Mr. *Flamsted* writes, " A hollow noise in the air always  
" precedes an earthquake, so near that it  
" rather seems to accompany them. He refers  
" us to *Philosophical Transactions*, No. 151,  
" p. 311. The noise was heard by many  
" that liv'd in the out-streets, and alleys of  
" *London*, remote from the noise and tumult  
" of the greater streets."

This he speaks of that felt in *London* 1692 ; but now the whole city heard the noise, on both these earthquakes of ours.

The gardener, who gave a relation to the Royal Society of what he observed in the *Temple-garden*, took notice, that first he heard the most dreadful noise imaginable, which he thought to be a great discharge of ship-guns, on the river : and that the noise rolled from the

the water-side towards *Temple-bar*, rather before the nodding of the houses.

The gentleman who observed it about *Hartingfordbury*, says, the noise preceded the shock. And this is a common observation, which at once both strengthens our opinion of electricity, and confutes that of subterraneous vapours; for, in the latter case, the concussion must precede the noise.

Agreeable to our *second* position, Mr. *Flamsted* writes, " That earthquakes are felt at sea, " equally as on land. Our merchants say, " that, tho' the water in the bay of *Smyrna* " lies level, and smooth as a pond ; yet ships " riding there feel the shocks very sensibly, " but in a very different manner from the " houses at land : For they heave not, but " tremble ; their masts shiver, as if they would " fall to-pieces, and their guns start in their " carriages, tho' the surface of the sea lie all " the time calm and unmov'd." In Dr. *Hook's Philosophical Collections*, N<sup>o</sup> 6. p. 185, we are told, " That a ship felt a shock in the main " ocean ; that the passengers, who had been " asleep in their cabins, came upon deck in a " fright, fearing the ship had struck upon " some rock ; but, on heaving the lead, found " themselves out of soundings."

All



All this is extremely agreeable to our assumption. The water receives the electrical touch, and vibratory intestine motion of its parts, as well as land. And the impression may be made solely on the water a non-electric, by the touch of an electric fire-ball, or the like; and that seems to have been often the case. The proper vibratory motion is impress'd on the water without ruffling its surface; and so communicated to all the parts of the ship, gives the sense of a shock to the bottom, the shivering to the mast, and the rest of the symptoms: which sufficiently proclaim the cause of it to be an electrical impression upon the water. The president mentioned a relation of a waterman, that felt it in his boat upon the river; he thought it like a great thump at the bottom of the boat. And so the ships at sea fancy, they strike upon a rock.

This makes us apprehend, the reason of the fishes leaping up out of the canal in *Southwark*, of which we had an account. So in that of *Oxford*, 1683, one fishing in the *Charwell* felt his boat tremble under him, and the lesser fishes seem'd affrighted by an unusual skipping. That electricity is the cause sought for, seems deducible from this consideration. Several writers on earthquakes assimilate these vibrations of the earth to those of a musical string.

Experi-

Experiments have shown, that fishes in water may be killed by the particular tone of a musical string ; and 'tis known, that electricity will kill animals. They assuredly felt the vibratory motion in the water, which they were absolutely strangers to before. No doubt it made them sick ; as those of weak nerves on land. And this circumstance alone precludes any suspicion of subterraneous fires under the ocean. Or, if we were to admit of it, would the boiling of the water exhibit any appearance, like what we are speaking of, either to the water, or to the ship ?

Mr. *Flamsted* likewise concurs in our *eighth* position, “ That many people found themselves suddenly sick at stomach, and their heads dizzy and light; so that those that had formerly fits of apoplexies, dreaded their return; particularly, one gentleman, a surgeon, feeling himself so affected, and fearing a return of his apoplexy, resolved to be let blood, without suspecting the earthquake.”

After these two shocks which we felt, many people had pains in their joints and back, as after electrifying; many had sickness, headaches, hysteric and nervous disorders, and cholicks, for the whole day after, and some much longer,

longer, especially people of weak nerves, weak constitutions; some women miscarry'd upon it; to some it has prov'd fatal.

To this we must attribute, that relation we had, of the dog lying asleep before the fire; but upon the Earthquake, he suddenly rose up, run about the room, whining, and endeavouring to get out.

Any solid matter is capable of being put into a state of electricity, such as iron guns; and the more so, by reason of their solidity. And in proportion to it, is the greatness of the snap, and of the shock; and a kind of lambent flame issues from the point of contact; and likewise somewhat of a sulphurous smell: So that if both flame and smell were discernable in an earthquake; 'tis to be found, without going to the bowels of the earth.

Dr. *Hales* mentions, that solid bodies are the best conductors of aerial lightning; whence oaks are rent, and iron melted. And in our earthquakes in *London*, the loudest noise was heard near such large stone buildings, as churches, with lofty steeples. From the top of these we must apprehend, that the electrical explosion goes off into the open air; as in our experiments, from the point of swords, and the like.

The



The electrical shock is proportionate to the solid electrified, agreeable to our *seventh* position. This fully accounts for earthquakes in general, and for many in particular. What can be imagined greater than a shock of the body of the earth? 'Tis greater, or less in proportion to the state of electrification. And now we can account for several appearances. In the first earthquake, the Lord Chancellor, Masters in Chancery, and several Judges, were sitting in *Westminster-Hall*, with their backs to the wall of the upper-end, which is of a vast thickness. They all relate the severity of the shock, from the wall seeming to push towards them with great violence.

And thus in the earthquake of 1692, *Deal* castle is one of them built by *Henry VIII.* the walls are of immense thickness, and strength; yet they shook so sensibly, that the people living in it, expected it was falling on their heads. And this is the case in all earthquakes: the more substantial the building, the more violent is the shock: exactly the mode of electrical vibration. And this *Dr. Hales* takes notice of and others; that an earthquake shatters rocks of marble, more easily than the *strata* of sand, earth, or gravel. In the earthquake here of 1692, a great cliff fell down near *Dover*; and part of *Saltwood-castle* wall.

'Tis from hence we account for that observation, that when we electrify any person ; upon a touch, the pain and blow of the shock is felt at the joints, the wrist, elbow, and shoulder, for instance, more than in the intermediate parts ; because *there* is the greatest quantity of solid.

At the same time, that the force of electricity in solids, is as the quantity of matter : we see most evidently, by innumerable experiments, that water is equally assistant in strengthening, and conveying the force of electricity ; and *that* in proportion too to its quantity. And hence is to be deduced the reason of my observation ; that the most frequent and dreadful earthquakes have fallen upon maritime places. And I find the same is taken notice of in some degree, by *Acosta*, by *Dolittle*, who wrote on that in 1692, and others.

In the dreadful catastrophe at *Port-Royal* then, 'tis notorious, that its violence was chiefly near the sea. So *Lima* could not suffer without its port of *Callao*. Even in those so lately felt by us, they were sensibly more violent towards the river, than farther from it.

In that earthquake which was felt in *England*, in the year 1692, (which was very much like these with us) there were no houses thrown down, nor Persons kill'd : but it reach'd

more

more particularly *Sheerness*, *Sandwich*, *Deal*, *Dover*, *Portsmouth*, and the maritime parts of *Holland*, *Flanders*, and *Normandy*.

In this that happen'd on *Sunday* the 18th of *March* last, at *Bath*; it was felt particularly and strongly at *Portsmouth*, seven miles above and below it on the sea-side; all round the isle of *Wight*, at *Southampton*, the sea-coast of *Selfey*, south of *Chichester*, *Arundel*, and the whole coast of *Sussex*, (without going up the land;) and across the sea to the islands of *Jersey* and *Guernsey*.

On *Monday* night, the 2d of this instant *April*, 1750, at ten o'clock, at *Liverpool*, a shock of an earthquake. And felt in several other places in the neighbourhood; but particularly at *Chester*, and *Warrington*.

If we look into ancient history, we find 197 years before Christ, an earthquake shook terribly the isle of *Rhodes*, damag'd many cities: and some quite thrown down.

Seventeen years before Christ, many cities in the isle of *Cyprus* destroy'd.

Six years before Christ, the isle of *Coos* vehemently afflicted.

During the *Peloponnesian* war among the *Greeks*, the isle of *Delos* shaken, and the most beautiful temple of *Apollo* thrown down.



# 36 *The Philosophy of*

Soon after, the city of *Lacedæmon* totally destroy'd.

*A. D.* 79. Three cities in *Cyprus* overthrown.

*A. D.* 82. The city of *Smyrna* ruined.

In the time of *Valens* the emperor, a terrible earthquake in *Crete*, whereby 100 cities were destroyed.

*Feb.* 13, 1247, An earthquake, chiefly felt in the *Thames*. *Matt. Paris*.

*May*, 1382, A general earthquake, which did much mischief; the *Friday* following one less; the *Saturday* following, one felt mostly by water. *Henry de Knyhton. Holinshed.*

*A. D.* 1456, In the city of *Naples*, 40,000 people lost.

*Constantinople* has often suffered; particularly in 1509, 13,000 people overwhelm'd.

1531, At *Lisbon*, 1400 houses thrown down; as many shatter'd.

*April*, 1690, The *Leeward-Islands*, *Montserrat*, *Nevis*, and *Antigua*: At *Martinico*, and the *French* islands, at *St. Lucia*, &c. a violent earthquake,

*Dec.* 8, 1703, An earthquake at *Hull*, a perfect calm.

1702, At *Strouton*, in *Argyleshire*, which extended all along the west coast of *Great Britain*; but to no breadth on land.

*Oct.*

Oct. 25, 1734, At *Havant*, in *Sussex*, considerable, the air perfectly calm.

But instances enough to show what I aim'd at, that maritime places are most subject; which is a strong argument in favour of electricity; when both the solid of the earth, and the quantity of the water concur, to make the shock; exactly as in electrical experiments; when the bottle of water is held in the hand.

Thus when our mind is discharged of the prejudices of former notions, we discern, that every appearance favours the principle we go upon. That, agreeable to Mr. *Flamsted*, subterraneous explosions, could they pervade, and traverse the earth at pleasure, must at last burst, and disperse every thing in their way. Yet, 'tis not possible for us to imagine, such a kind of vibration should follow, either by sea or land, as that we are treating of. But electricity compleatly answers it. This accounts for that superficial movement of the earth, that universal instantaneous shock, which made every house in *London* to tremble, none to fall: That quivering, tremulous, horizontal vibration, highly different from any motion we must conceive, to be produc'd from subterraneous evaporations. Hence authors tell us, Dec. 30, 1739, describing an earthquake in the west-Riding of *Yorkshire*: It seem'd as if

the earth moved backward and forward horizontally; a quivering, with reciprocal vibrations.

Mr. *Flamsted* rightly accounts the motion of earthquakes to be undulatory; and by being continued, causes a like motion to a great distance. As when you strike a long stretched string of wire at one end, the motion is immediately continued to the other. So far he entered into the nature of electricity.

Tho' he be in the right, thinking the cause comes from the air, yet what follows contradicts his own hypothesis. "For if a calm be  
" necessary before an earthquake; then 'tis not  
" produced by any turbulence in the air. Nor  
" can we imagine that any aerial commotion,  
" tho' it may shake windows, chimneys, and  
" the like, shall reach 500 miles distance, split  
" the solid earth, destroy whole cities, and cause  
" those dire desolations we hear of.

" Mr. *Flamsted* mentions a circumstance, that  
" the earthquake here in 1692, was not felt in  
" the north of *England*, nor in all *Scotland*: for  
" rain fell that day in both." We may very readily conceive, the earth there was not in an electrified state; and the rain would sufficiently prevent it. We hence understand, how the southern regions should be more subject to them, than our northern; where the warmth,  
and



and driness of the air, so necessary to electricity, is more frequent than with us.

From electric vibration only can we account for our *tenth* position, of springs, and fountains being no ways damag'd by earthquakes: The motion goes no deeper into the earth, than the force and quantity of the shock reaches; which generally is not far; yet it proceeds lower down when the ready passage of a well offers, and *there* affects the water contained in it; puts it into an intestine vibration, as to foul it, and raise mud from the bottom.

It may seem difficult to conceive, how a large portion of the earth's surface should be thus capable of electrification. This difficulty is lessened by reflecting on the nature of electricity, and of the electrical, ethereal fluid pervading all things: how it is excited by the little motion of a small revolving glass globe. By this we electrify the most solid bodies, to the greatest distance, and with a velocity equal to that of lightning.

Dr. *Hales* observes, that the usual explosion of the cannon on great days, in *St. James's Park*, is observ'd to electrify the glass, in the windows of the Treasury.

We must conceive, that when the electric shock is communicated to one part of the earth, it extends itself proportionably to the force of

the shock, and to the quantity of electrified surface; and to the quality of the matter more or less susceptible of it, more or less apt to propagate it.

Set 1000 men in a row; let every one communicate with those next him by an iron-wire held in their hands: on an electrical shock they all feel it alike, at the same instant; and this gives us a very good idea of the earthquake.

When the earth is broken up in any large degree, 'tis by the sea-side; where sometimes on a bold shore, whole streets tumble into the sea, or into the gaping earth, now falling toward the sea. Sometimes on a flat and sandy shore, whole streets are rolled along the level into the sea.

I am not sensible of any real objection against our *hypothesis*, but this, being the *eleventh* of my positions, or circumstances. It seems true, that earthquakes are more frequent in *Italy*, near *Vesuvius*, and by *Ætna*, in *Sicily*. And the cause seems apparently owing to these volcanoes. At first sight, every one would think so, but not from the true reason. This has given the great prejudice to the judgments of the curious, even at this day. But consider the matter impartially, and it will appear, so far from being a strong argument in favour of subterraneous

aneous eruptions, that it ought to be esteem'd a convincing proof to the contrary, and most cogent in favour of my principle. In strictest logic, there is no inference to be made from particulars, to generals. Quite the contrary. We have but these two or three vulcano's on one quarter of the globe, and two of them toward the warmer climate of it; whereas earthquakes are innumerable, especially in those of a warmer clime. That there are no vulcano's, no discharges of fire and smoke for a continuance, and abundance, after earthquakes; no suspicion of it either from sight or smell, as we know by innumerable examples, as well as in our own country, and experience: is demonstration, that this is not the cause. If the vulcano's were the real cause of earthquakes, we ought assuredly to expect, that in the countries thereabouts, the earthquakes ought to be far more extensive than those in other countries, where are no vulcano's; but this is altogether contrary to experience. For, as the celebrated naturalist *Buffon* observes, such are not extensive, as are near *Ætna* and *Vesuvius*. He further adds: *Histoire naturelle*, tom. 1. p. 508. speaking, among many others, of a vulcano in the island of *Ternate*, he remarks, " That this burning gulph is less agitated when  
" the air is calm, and the season mild, than in  
" storms



“ storms and hurricanes ;” and says, “ This  
 “ confirms what I have said in my foregoing  
 “ discourse, and seems evidently to prove,  
 “ that the fire which makes *vulcano*’s comes  
 “ not from the bottom of mountains, but from  
 “ the tops, or at least from a very little depth ;  
 “ and that the hearth (or floor) of the fire is  
 “ not far from the summit of the *vulcano*’s ;  
 “ for, if this was not the case, great winds  
 “ could not contribute to their conflagration.”  
 And this, in general, is a corroborative proof  
 of my whole hypothesis. For there can be no  
 great fire in the earth, where there is no great  
 conveyance of air.

We have one *vulcano* in the cold region of  
*Iceland*, that there is sometimes an earthquake  
 there ; but, in the countries of that northern  
 latitude, and those of lesser, ’tis obvious in all  
 history, that earthquakes are less frequent than  
 in the more southern. Therefore ’tis easy,  
 and very natural to conclude, from all confi-  
 derations weighed together, that these *vul-*  
*cano*’s help to put the earth about them, into  
 that vibratory state and condition of electricity,  
 which is the requisite in my *hypothesis* ; and by  
 that means only, promote a frequency of earth-  
 quakes there.

I have only one circumstance to add, which  
 may seem not inconsiderable ; probably per-  
 ceived

ceived by many, tho' not taken notice of. For a whole week before the first earthquake, the partition wainscot of my house (between the forward and backward rooms) made an odd kind of tremulous, crackling noise continually, as if the wainscot would split ; or as if some damage was apprehended to the house. This was observ'd by the family, with a good deal of concern. *That* in the chamber crackled more than that below. We never perceiv'd it before or since, and apparently, it shows the vibratory state of the surface of the earth, at that time.

But whether our conjectures upon this important subject be well founded or no, it certainly becomes a christian philosopher, whilst he is investigating material causes, to look up, and regard the moral use of them. For in reality, every thing, the whole world, was ultimately for that purpose made. When we see such a kind of spirituality impress'd on mere matter, as this amazing property of electricity, it should kindle in us a high ambition of asserting, and exerting the infinitely superior value, and powers, and excellency of the spiritual part of us, destin'd to an immortal duration. And of all the great and public calamities, which affect us mortals, earthquakes claim the first title to the name of warnings  
and

and judgments. None so proper to threaten, or to execute vengeance upon a guilty people. Nor has any other, those annexed terrors, so much of the unusual, the unavoidable, the sudden and the horrible apprehension of being crush'd to death, or buried alive. And when in our own sight, these rare and extraordinary *phænomena* appear, it cannot but be a lesson to us, to do our duty toward that great Being, who, by a drop of water, can produce effects so prodigious.

That earthquakes proclaim themselves to mankind in this light, is further deducible from this observation, the *ninth* in our recapitulation of circumstances; that they are peculiarly directed to great cities, and maritime towns, those nurseries of wealth, luxury, and of all the evils naturally flowing therefrom. It would be childish to rehearse from old history, or modern, a proof of it. We have no other notices of them. Look upon these two shocks we have here felt. We own that *Hampsted-beath*, and *Finchley-forest*, and *Kennington-common* were affected with it; yet it is notorious, that *London* was the center, the place to which the finger of God was pointed.

And this leads us in the *third* place, to consider the moral use and purpose of these *magnalia naturæ*, and prodigies of the agency of material



terial causes. For nothing sure, but an electrical shock, and that from a divine hand, could have been so well adjusted, as twice, nay four times, so sensibly to shake every house in *London*, and not throw one down. This duty we will endeavour to execute, from the words of that great man, king *David*.



PSALM

## P S A L M    xviii. 7.

*Then the earth shook, and trembled; the foundations also of the hills moved, and were shaken; because he was wroth.*

**T**HIS Psalm is a triumphal song, which *David* deliver'd publicly before God, in thankful remembrance of the great mercies he had receiv'd; being firmly established on his throne: and all his enemies, foreign or domestic, subdued.

He does not attribute this happy situation of his affairs to his own prudence and courage; but, like a consummate politician, absolutely to the mediation of the divine providence. He draws up a most grand and magnificent description of the advent of the deity, such as words never before expressed. All the heathen pictures of the appearance of their gods, are cold and lame, compar'd to this; which is deservedly so much admir'd by all critics that have any taste for religion, as well as language.

This verse, in our text, is the first movement in the scene, which was to represent the appearance of *Jehovah*, without whose interposition *David* hoped for nothing fortunate.

After

After describing all the pomp of light, and darkness, celestial; hailstones, thunder, lightning, and the like instances of majesty and terror, in the skies; he still keeps his eye on the ground, and concludes with the earthquake, where he began.

*Then the channels of waters were seen; and the foundations of the earth were discovered; at thy rebuke, O Lord; at the blast of the breath of thy nostrils.*

Our holy psalmist, at other times, has exhibited the same images, in different colouring; as a great master varies his works, to strike out all the beauties.

*Psal. lxxviii. 7. O God, when thou wentest forth before thy people; when thou didst march thro' the wilderness; the earth shook, the heavens also dropped, at the presence of God. Even Sinai itself was moved, at the presence of God; the God of Israel.*

By this he means, the giving the law. *Exod. xix. 8. And mount Sinai was altogether on a smoke; because the Lord descended on it in fire: and the smoke ascended as the smoke of a furnace, and the whole mount quaked greatly.*

Again, *Psal. cxiv.* when he is describing the passage over the Red-sea, and that over Jordan; he brings in the machinery of earthquakes, to testify the divine presence.

*When*



*When Israel went out of Egypt, and the house of Jacob from among a strange people; the sea saw it and fled. Jordan was driven back.*

*The mountains skipped like rams: and the little hills like young sheep.*

Then he asks the question, *What ailed thee, O thou sea, that thou fleddest? and thou Jordan, that thou wast driven back?*

*Ye mountains that ye skipped like rams, and ye little hills like young sheep?*

He answers: *Tremble thou earth at the presence of the Lord: at the presence of the God of Jacob.*

He fails not to attribute these marvellous appearances, to their true cause. Tho' he knew full well, that the God of nature administered the ordinary course of the earth by second causes; yet he could not be so blind but to perceive, when the waves of the ocean retreated; when the waters of *Jordan* divided; when mount *Sinai* was all in fire, smoke, lightning and thunder, with the trumpet of God sounding, and the whole mountain shaking: he could not but perceive the presence of the author of nature, in these extraordinary appearances.

But every where in sacred scripture earthquakes are particularly singled out, above all other natural *phænomena*, as having more of the

the majesty and terrific pomp, to denote an immediate operation of God's hand ; to excite our fear, and shew his anger, 'as in our text, *because he was wroth*. In imitation of the sacred writers, the heathen poets, both *greek* and *latin*, express the anger of their *Jupiter* by an earthquake :

*Terrificam capitis concussit terque quaterque*

*Cæsariem ; cum qua terram, mare, sidera,*  
*mōvit.* Ovid.

The moving meteors in the free air, lightning, coruscations, fire-balls, tempests, thunders, or the dreaded comets, tho' frightful enough ; yet people that do not think to any purpose, hope, as they are at a distance, to escape their effects. But when the terror comes home to us, to our feet ; when the earth moves on which we stand, what heart is not moved ? When our houses *shake* over our ears, the greatest courage is *shaken*.

It is true, an earthquake causes an universal dread among all sorts of people ; even the philosopher immersed in speculation of second causes, quakes ; as well as the pious, whose fear proceeds from solid piety : a due sense of the *anger* of the almighty Being.

D

We

We saw how the late earthquakes affrighted every one; but, as to the generality, it was but for a moment. When they found themselves safe, and alive; thoughtless they ran to their business, or their diversion: and this not only the first, but the second time. And I am apprehensive, were another, and another to come, they would only be less regarded than the preceding. As the *Israelites*, to whom miracles became familiar; as the *Jews*, in our Saviour's time, demanding of him to show them a sign from heaven, in the midst of the constant scene of miracles innumerable.

But 'tis my present business to call you to a due and serious reflexion, on these extraordinary events; by considering,

I. What the written word of God, the holy scriptures, informs us, concerning the ultimate purpose of earthquakes.

II. What we can learn from profane history.

III. To conclude with our text, that they are strictly and properly divine judgments; *because he was wroth.*

Ever since the earth began, earthquakes have been looked on as extraordinary appearances, among the prodigies of nature, and executioners of divine justice. In the case of *Korah*, *the earth opened her mouth and swallowed them up; and their*



*their houses, and all the men that pertained unto them; and all their goods.*

In the miraculous victory obtained by *Jonathan*, and his armor-bearer, over the army of the *Philistines*, 1 *Sam.* xiv. There was a panic terror infused into the *Philistines*, and an earthquake: it is called *a very great trembling of God*. What the heathen attributed to *Pan*, an imaginary deity of their own making: the *Hebrews* rightly refer'd to the true cause, the first, and supreme.

In the New Testament, at our Saviour's death, there was a great earthquake, which was altogether miraculous; as much as the eclipse of the sun then. The elements might well sympathize with the God of nature. *The sun was darkned, the vail of the temple was rent in twain; the earth did quake, the rocks rent.*

Again, at his resurrection, *Matt.* xxviii. 2. *There was a great earthquake. The angel of the Lord descended from heaven, and rolled back the stone from the door, and sat upon it.*

*And for fear of him the keepers did shake, and became as dead men.*

*Matt.* xxvii. 54. *When the centurion, and they that were with him, watching Jesus, saw the earthquake, they feared greatly. See the consequence of it in one place; and thus in another:*

*Acts iv. 31. The Apostles, in the infant Church, when praying, the place was shaken, where they were assembled together : and they were all filled with the Holy Ghost. The heathen centurion feared upon the earthquake : The christians praying, were filled with the Holy Ghost.*

*Acts xvi. 26. When Paul and Silas were in prison. At midnight when they prayed, and sang hymns to God, suddenly there was a great earthquake ; so that the foundations of the prison were shaken. And immediately all the doors were opened, and every one's bands were loosed.*

Observe the consequence it had upon the goaler ; *He called for a light, and sprang in, and came trembling, and fell down before Paul and Silas, and said, Sirs, what must I do to be saved ?*

The goal trembled ; and the goaler trembled, as is observed by a writer on this head, an earthquake could *soften his hard heart, and open what he had lock'd.* It awaken'd him out of his spiritual slumber, as well as his natural sleep, and made his conscience, as well as the foundations of the prison, to quake. A bad conscience is *as a troubled sea, that cannot rest, but casteth up mire, and clay.* The goaler perceiv'd the celestial warning, and made a proper use of it.

There

There are many circumstances in the nature of earthquakes, which render them peculiarly proper to be the instruments in God's hand, to give warning to a people, to amend their ways.

The *suddenness* is one. We saw not long ago, what an effect was produced by a solar eclipse, though it was expected long before. We had the prediction, and calculations about it in all our almanacs; yet there was an universal seriousness that followed it. All that morning, we could walk the street, without hearing an oath, and the churches were full, in time of prayer. But the *suddenness* of an earthquake that comes at an instant, unthought of, without warning, that seems to bring unavoidable death along with it; is able to touch an adamant heart. To see death stalking o'er a great city, ready to sweep us all away, in an instantaneous ruin, without a single moment to recollect our thoughts; this is fear without remedy; this is far beyond battle and pestilence. The lightning and thunderbolt, *the arrow that flieth by day*, may suddenly take off an object or two, and leave no space for repentance: but what horror can equal that, when above a million of people are liable to be buried, in one common grave!

Another consideration that enhances the dread of earthquakes, is the *unavoidableness* of the ca-



lamity. Famine, and war, and rebellion, and pestilence we may run from, the disease among the cattle, and locusts, and the like stripes of angry Heaven, we may have some chance to escape: but no means, no precaution, no remedy, no prudence can screen us, from so universal a desolation as this: 'tis as the presence of God. Whither then can we go to hide ourselves? Must we call upon the rocks and mountains, to cover and shelter us from the divine wrath! *And they shall go into the holes of the rocks, and into the caves of the earth, for fear of the LORD, and for the glory of his majesty; when he ariseth to shake terribly the earth.* Alas, those are the very instruments he employs for our destruction; to be our tombstones!

This *unusual* kind of death too, strikes us with horror; to be buried alive. The earth, the common mother of us all, and the common grave; to eat up her offspring alive; crouds all the images of amazement together, that can enter into the heart of man.

The greater the terror accompanying earthquakes, the greater a blessing is our deliverance from the danger of it! What can equal God's power and judgment but his mercy? Consider the wonderful consequence; that the whole city of *London* should so sensibly be shaken, and yet no one inhabited house to fall; nor one person  
kill'd.

kill'd. Amazing instance of power, and goodness, in our preservation! And this not only once, but the second time also; though evidently stronger was the concussion. So strong that almost every person was thoroughly persuaded, that some part, at least, of their houses, was falling down. Can we help admiring, that judgment should be so temper'd with mercy! Do we look only at the second causes with our unbelievers; and sport away the divine presence, as if it was an ordinary occurrence of every day? They want to see a miracle. Nought can effect them, but a direct supernatural agency.

I answer, behold a visible, and notorious miracle; plainly obvious, and before all their senses. For can there be a greater miracle, can any thing be more directly the finger of God than this, which we ourselves saw with our eyes; that befel the whole city of *London*.

We know the nature of the building of *London* houses; which sometimes fall of themselves, without shaking. Wonderful then is it to be thought, and a miracle indeed, that every house in this vast city, should twice be agitated, and rocked to and fro; and not one fall, nor one person receive any damage.

In vain will the philosophers seek for a solution of this problem, in natural causes only.

By their chymical experiments, they make some little mimic imitations of tremors and fumes, and explosions. So by gun-powder, we ape the regal voice of thunder. But where is the discretionary act of mercy, and benignity, that separates between the vengeful and kind? These second causes act according to their material nature, like the roaring waves of the ocean, that flow in, and overwhelm every thing, where a breach is made. They can observe no distinction between the lands of a righteous man, and of a sinner: they cannot stop at a breach, and gather themselves on an heap, and not enter in at all, as the waters of *Jordan* did.

But in the case before us, the hand of the Lord, that stayed the flowing of the waters, that quelled the raging of the sea, and its proud waves; sets bounds to the trembling of the earth. Hither shall its vibrations go, and no further. When alas, if it went but one inch further (in comparison) a total ruin must unavoidably follow.

Consider this particular, when applied to all the buildings in this immense city: and wonder and adore, that almighty providence, which overlooked us, and prescribed the limits; so narrow, so precise; which saved us from universal havoc!

II. Did



II. Did we escape ; how much happier are we, than the millions that have perished by the like calamity ? *Josephus* the famous *Jewish* historian records, that about 29 years before our Saviour's birth, there happened such an earthquake in the country of *Judea*, that 30,000 men perished.

In the fifth year of the reign of *Tiberius*, so dreadful an earthquake happened in *Asia minor*, that no less than 13 cities were destroyed in one night ; many of them great, and Royal : *Sardis* in particular, said to be second to *Babylon*.

In *A. D.* 66. Another earthquake happened there, which destroyed *Laodicea*, *Hierapolis*, and *Colossus*.

*A. D.* 79. Three cities in *Cyprus* were overthrown.

*A. D.* 114. The City of *Antioch* suffered extremely ; whilst the emperor *Trajan* was in it. And in the 7th year of that emperor, nine several cities were destroy'd in *Asia*, *Greece*, and *Calabria*.

To come nearer home, and our own times : In 1169, *Catania* in *Sicily* was destroyed, and 15,000 people killed.

1692, The whole city destroy'd and 18,000 Inhabitants.

1456,

1456, At *Naples* 40,000 perished by an earthquake.

1531, In the city of *Lisbon*, 1400 houses were overthrown there, besides many damaged.

We know the miserable and deplorable catastrophe of *Port-Royal*, in *Jamaica*; which fell out in our own days. My blood shudders at the relation of it. And not many months ago, the populous *Lima* in *America*, was wholly overthrown.

Have we not reason then to fear, for ourselves? 'Tis true, we have hitherto escaped. But can we tell how soon God shall let loose the avenging power of another; which may come, for ought we know, while we are speaking of it. And if it must come, happy may it be for us, that it finds us in this place, and so doing.

III. And this brings us to consider the uses of these admonitions; and to show, that they are the effects of the divine anger. *For the earth shook and trembled, says the holy psalmist, the foundation of the hills moved and were shaken; because he was wroth.*

And here we cannot possibly have a stronger and more convincing evidence, of these convulsions of nature, being the immediate finger of God, than this single consideration. Let us but reflect on what has been said, in short;

that

that these visitations only happen to great and populous cities, to great and eminent ports, and maritime *emporiums* flourishing in trade, riches, and luxury.

We hear not of barren deserts, uninhabited wildernesses, wide heaths, and downs, rocky cliffs, and beaches of the sea, to be the usual subject of earthquakes; but of towns and cities. Not so much of little villages, but of those immense collections of people. God does not give his warnings to birds, and beasts of the forest; to flocks of sheep; that punctually execute the respective offices he has enjoined them: but to us, the lords of the creation; to whom he has given reason, sense, and faculties, to reflect, and judge of things, of our own actions, as well as his; of *his* doings, toward the children of men.

We observed before, a plain and notorious proof of God's hand in these judgments; that he could move a whole city without throwing down a house. And this is most assuredly a second proof; that he visits *only* great cities, with these judgments. And we must conclude this to be as strong an argument of a divine interposition in these affairs, as any mathematical demonstration.

Some free-thinkers, or free-livers, when they find, they cannot set aside this reasoning, shelter themselves,



themselves, with the history of God's converse with *Abraham*; about the cities of *Sodom* and *Gomorrah*; assuring themselves, there is no danger. For though they cannot pretend to be the meritorious people; yet they think God's mercy will be as signal to us, as heretofore: and that we have among us, at least ten righteous persons, to save the rest.

But vain are such hopes: God will say to them, as heretofore to the *Jews*: *If I bring my great judgments upon the earth, as I live saith the Lord, though Noah, Daniel, and Job were there, they should save neither sons, nor daughters, but their own souls only.*

God can, if he pleases, by very extraordinary means, preserve such as he thinks fit. But in general judgments, the righteous must undergo one common fate, with the wicked. God's mercy will be shown to them after this life, to make the superabundant amends.

But this is a solid lesson to us, of the necessity of a future life. We may as well banish God out of the earth, as to deny his attributes of power, and goodness, and justice, and the like. And these will insure us of a future state; when an exact return will be made for our behaviour in this; otherwise we might justly expostulate, as *Abraham* did, *Will not the judge of all the earth do right?*

Good

Good men, who have endeavoured to do their duty, may say, *God is our refuge and strength, a very present help in trouble. Therefore will not we fear, though the earth be removed; though the mountains be carried into the midst of the sea; though the waters thereof roar, and be troubled; tho' the mountains shake with the swelling thereof.*

*Come, behold the works of the Lord; what desolations he hath made on the earth.*

In the mean time, let us not think on running away from the danger, so much as on mending our ways; perfecting the christian life; reforming the abominable crimes, so justly chargeable on great and maritime cities; overflowing with riches, pride, and luxury, with vanity, pleasure, and profaneness; with gaming, immorality, infidelity; and especially with the notorious crime of sabbath-breaking, which is the foundation of all, and comprehends all others; for it prevents people from amending of any. If they fail of their duty towards God, in making their regular approaches to his temple; no wonder they are guilty of all crimes; regard neither God nor man. If they fail of coming, where they may hope for the kindly influences of God's holy Spirit; we need not wonder at their egregious wickedness: they become absolutely irreclaimable.

But

But of you my beloved brethren, here assembled, I hope better things. You shun the degenerate corruptions of this evil age; you are not of the number of those that frequent our public meetings of folly, from the morning rendezvous to the midnight assemblies; and *that* protracted to the morning light again. As if we ought to banish all serious thoughts of our immortal interests; and that in the sacred season of Lent; destined by the church, for this very serious purpose.

Let us think how this warning happened to us, in the time of Lent; when they were revelling in their places of entertainment, both morning and evening, as if no such thing had been; and this on the very days; as if they confronted, and dar'd almighty vengeance. Much of a parallel case with that of the famous city of *Herculaneum*, which is now the entertainment of the curious. First it was miserably shattered by an earthquake; whilst the people were at their diversions in the theatre; where all assembled perished. This was in the first year of *Titus* the emperor: but such a partial judgment not mending their manners; nine years after, the whole city was destroyed by a lake of liquid fire and brimstone, from mount *Vesuvius*, just in the manner we now find it; 50 foot deep in cinders, and ashes.

*When*



*When thy judgments, O God, are abroad, the inhabitants of the earth will learn righteousness.*

*The Lord is the true God; he is the living God; the everlasting King: At his wrath, the earth shall tremble, and the nations shall not be able to abide his indignation; says the prophet Jeremiah, x. 10.*

God give us grace, that instead of these short-lived, and unsatisfying pleasures; instead of palaces and houses here, ornamented in a sumptuous and elegant *taste*; which may perhaps be swept away, with their owners, in a moment; we may aspire towards that heavenly city, which is above; whose foundations are not laid with hands, eternal in the heavens, &c.



When the judgment, O God, be done, the in-  
habitants of the earth will learn righteousness.

The Lord is the true God; he is the living God;  
the ever-living King: At his word, the earth  
shall tremble, and the nations shall not be able to  
abide his indignation; says the prophet Jeremiah,

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city, which is above; the foundations are not  
laid with hands, of the heavens, &c.



THE  
PHILOSOPHY  
OF  
EARTHQUAKES,  
NATURAL and RELIGIOUS.  
PART II,

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*Philosophi ipsius, qui de sua vi ac sapientia unus omnia pene profitetur  
est tamen quædam descriptio; ut is qui studeat omnium rerum di-  
vinarum atque humanarum vim, naturam, causasq; nosse: &  
omnem bene vivendi rationem tenere, & persequi; nomine hoc  
appelletur.*

Cicero de Oratore.

---

By WILLIAM STUKELEY, M.D.  
Rector of St. George's, Queen-Square; Fellow  
of the College of Physicians, and of the Royal  
and Antiquarian Societies.

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L O N D O N:

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Church, *Fleetstreet*.

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M.DCC.LVI.



THE  
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By WILLIAM STURGEON, M.D.  
F.R.S. &c. &c.  
Fellow of the Royal Society, and of the Royal  
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L O N D O N .

M.DCC.LVI.

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## P R E F A C E.

**T**HIS discourse is but a necessary consequence of the preceding. The whole no other than an essay, toward investigating the true nature of the wonderful appearance of an earthquake. And something is done toward it, if only by eradicating an old error. In attaining the proposed end, I have endeavoured to lay all the necessary circumstances together, which to our great amazement we have seen and felt. That they may not be as soon forgotten, as they generally were, by the giddy multitude; equally thoughtless of what they knew to be past, as childishly fearful of an imaginary one, subsequent: for which there could not be the least ground of apprehension. By sober persons it was, with great reason, thought a judicial infatuation, and as much to be wondered at, as an earthquake itself; a real panic. When a third part of this immense city ran out into the fields for half a cold night; alarmed with the silly prediction of a distempered fellow!

Nothing could tempt one to commemorate the follies of our cotemporaries, but the hope, it may be useful hereafter: and to show the true cause of this senseless terror; the want of a true sense of

*religion; and an universal degeneracy, and corruption of manners: begun by the great ones, and now propagated through all degrees to the lowest: begun in this great city; and now advancing apace to every great town in the kingdom.*

*'Tis from the great ones alone, that we can hope for a reformation: and that by a strict observance of the sabbatical duty. Example, we know, governs the actions of mankind. That must restore the practice, and the influence of religion: which alone can prevent the dangers that infest every corner of our streets; every road in the kingdom. We mistake the point, and betray our ignorance in human nature, when we think, acts of parliament, laws, and executions will do it. They are very weak in comparison of the impressions of religion, and conscience: as all philosophy both natural and religious, has hitherto thought, and known.*



T O



T O  
*Martin Folkes, Esq; LL. D.*  
 President of the Royal Society.

SINCE I had the honour to lay before the Society, in the spring, my thoughts upon earthquakes: we have had many further opportunities of reflecting upon that most awful, and hitherto unusual appearance. An earthquake was felt at *Eastwell* in *Kent*, on *Monday, March 12*, and on *Sunday, March 18*, at *Portsmouth*, the *Isle of Wight*, *Southampton*, and along the coast of *Sussex*, the isles of *Guernsey*, *Jersey*. *April 2*, a smart earthquake at *Manchester*, *Liverpool*, *Taunton*, *Bath*, *Flint*, *Lancaster*, *Wrexham*, reaching 40 miles north and south: 70 miles east and west. Since then at *Rome*, *Naples*, *Leghorn*; in the south of *France*, and at *Pau* under the *Pyrenean* mountains; *Oporto*, at *S. Macaire* in *Guienne*, *Messina* in *Sicily*, *Munich* in *Bavaria*, &c. &c. so that the year 1750, may rather be called the year of earthquakes, than of jubilee. For since *February* last, when they began with us at *London*; as far as I can learn, they have

appeared in many parts of *Europe, Asia, Africa,* and *America.* And have likewise revisited many counties in our own island, and at length, on the 30th of last *September* gave much the most extensive shock, we have seen here in our days.

It may be well expected, that these frequent visits, in themselves so very extraordinary, to us so rare, and *that* in one year, should keep up our attention: and as to my own part, induce one to reflect, on what I before offered concerning them; and be a sufficient apology for the present paper.

We have been acquainted, by those who remember it, that in the earthquake of *Nov. 1703*, which happened in *Lincolnshire*, the weather was calm, close, gloomy, warm, and dry; in a degree highly unusual, at that season. And thus it has been with us all the year. And from the numerous accounts we have received at the Royal Society, in the beginning and ending of the year; where any mention is made of the weather; they all agree in the like particular. Which is consentaneous to what I remarked, as the constant forerunner of earthquakes; and what prepares the earth's surface, for the electrical stroke: which I asserted to be the cause of them.

In *May* last, we had a paper read at the Royal Society, concerning the second earthquake felt by us at *London*, on the 8th of *March*. A shepherd belonging to Mr. Secretary *Fox* at *Kensington* (the sky being perfectly serene, and clear) was much surprised with a very extraordinary noise in the air, rolling over his head, as if cannon close by. He likewise thought, that it came from the north-west, and went to the south-east: a motion quite contrary, to what must have been the case, if it were really of cannon. This noise passed rushing by him; and instantly he saw the ground (a dry, and solid spot) wave under him, like the face of the river. The tall trees of the avenue, where he was, nodded their tops very sensibly, and quivered like a shaken spear. The flock of sheep immediately took fright, and ran all away together, as if dogs had pursued them. A great rookery in the place, were equally alarmed, and after an universal clangor, flew away; no less than if chased by hawks.

I was likewise informed, that in the same earthquake, a great parcel of hens, and chickens, kept at that time in *Grays-inn-lane*, upon the shock, ran to the roost, affrighted. And the like was observed of pigeons. And in our last account of the earthquake from *Northampton*, 'tis remarked, that the birds in cages put



their heads under their wings, as to hide themselves.

June 21, at the Royal Society, Mr. Jackson, potter at *Lambeth*, gave an account of some boats, cibles, and lighters in the river, at that time; the people in them seem'd to feel, as if a porpoise, or some great fish had heav'd and thump'd at the bottom of the vessels. This is sometimes the case of ships at sea, when all is perfectly calm: which seems evidently owing to an electrical impresson on the water.

In the *Whitehall Evening-post* of June 23, we had a paragraph from *Venice*, that a terrible earthquake had been felt lately in the little rocky isle of *Cerigo*, in the *Mediterranean*, south of *Morea*. It threw down a great number of houses; and above 2000 of the inhabitants were buried in the ruins.

Another earthquake about that time, happened in *Switzerland*; which split a vast rocky mountain; and an old castle wall of an immense thickness.

All these circumstances, and many more, confirmed me in my former opinion. But since then, these wonderful movements have stalk'd round the globe: and again been lately felt in our own island; happily for us, to the terror only of many thousand people: beside those concussions of this sort that appeared in the western

western parts, in the more early time of the year.

I received a letter from my friend *Maurice Johnson*, Esq; the founder, and secretary of the Literary Society of *Spalding* : which has now subsisted these 40 years. He acquaints me, that on *Thursday*, 23d of *August* last, an earthquake was very sensibly felt there, about seven o'clock in the morning; throughout the whole town and neighbourhood; and many miles round; but that it chiefly spread itself northward, and southward. He says, that for a fortnight before, the weather had been serene, mild, and calm. And one evening, there was a deep red *aurora australis*, covering the cope of heaven, very terrible to behold. This same shock was felt at *Grantham*, *Stamford*, and *Milton* by *Peterborough*; and generally at all the intermediate places; and from *Spalding* it fled northward, along the sea shore, to *Boston*: thence up *Boston* river, to *Lincoln*.

Since then, I had a letter from Mr. Alderman *Taylor* of *Stamford*, giving an account of another earthquake, that happened there, *September* 30, at 36 minutes after twelve o'clock at noon. He describes it thus. They were suddenly surpris'd with an uncommon noise in the air, like the rolling of large carriages in the streets, for about 20 seconds. At the same instant

stant they felt a great shake, or snap, as he calls it; insomuch that it sensibly shook a punch-bowl, which was in his parlour, and made it ring. He says, it was perceiv'd of most of the people of *Stamford*, who generally ran out of their houses. At *Oakham* the chief town of *Rutland*, the congregation ran out of the church whilst the preacher was in the pulpit. All the towns round *Stamford*, were sensible of it: and at *Peterborough*, down to *Wisbech*,

Thus far the Alderman. But we have had many advices from all hands, at the first, and second meetings of the Royal Society, for the winter-season; with further particulars relating to this great concussion. That it was felt at the same time, at *Rugby* in *Warwickshire*, and reach'd to *Warwick*, at *Lutterworth*, in *Leicestershire*: at *Leicester*, and round about. It extended itself to *Cowentry*, *Derby*, *Nottingham*, *Newark*; then came eastward to *Harborough*, *Towcester*, *Northampton*, *Rowel*, *Kettering*, *Wellingborough*, *Oundle*, in *Northamptonshire*; *Uppingham*, *Oakham*, in *Rutland*; *Stamford*, *Bourn*, *Grantham*, *Spalding*, *Boston*, and to *Lincoln* in *Lincolnshire*; *Holbech*, and all *Holland* in that county. *Peterborough*, *Wisbech*, in the isle of *Ely*; together with all the intermediate, and adjacent places. Then it pass'd over the whole breadth of *Ely* fen: was felt at *Mildenhall*, and reach'd



reach'd to *Calford* by *Bury* in *Suffolk*, and the country thereabouts; of which we had notice from lady *Cornwallis*. An extent from *Warwick* to *Bury* of about 100 miles in length; and generally speaking, 40 miles in breadth. And this vast space was pervaded by this amazing motion, as far as we can get any satisfaction, in the same instant of time. They describe it, that the houses totter'd, and seem'd to heave up, and down: though it lasted but a few seconds. It was attended with a rushing noise, as if the houses were falling, and people were universally so affrighted, as to run out; imagining that their own, or their neighbours houses were tumbling on their heads. In the villages around, the people being generally at divine service, were much alarm'd: both with the noise, which exceeded all the thunder they had ever heard, beyond compare: and with the great shock accompanying; which was like somewhat, as they imagined, that rush'd against the church-walls, and roof. Some thinking the pillars crack'd, many that the beams of the roof were disjointed; and all, that the whole was falling. And happy were they that could get out first. Many people fancied, that nests of drawers, and cabinets, or the like heavy things, were fallen down above stairs: or that chimnies had broke through the roof of the house;

house: or that some persons fell down stairs: and the like. Some perceived the crackling of inward wainscots or partitions: as Dr. Mortimer and I observ'd in our first and second shocks at *London*. A few slates, tiles, and parts of chimnies fell from some houses: pewter, china, glasses, and brass from shelves. A clock bell, chamber bell some time struck: windows universally rattled, and the like circumstances of tremor.

In regard to circumstances, they were pretty similar throughout. Many people sitting in their chairs relate, that they and their chairs were several times sensibly lifted up and set down again. A stack of chimnies were thrown down in *College-lane*; a place retaining the memory of a sort of university once beginning at *Northampton*. The windows of houses rattled throughout the whole town: but no mischief done: in general it was frightful, and innocuous.

They fancied there, the motion of it, as they expressed it, to be eastward. In streets that run north and south, the houses on the east side of the way, were most affected. And Dr. *Stonehouse*'s dwelling, the strongest in the town, was most sensibly shaken. So it was likewise observed, that churches were most subject to its violence. They thought too, that the motion

tion seemed rather horizontal, or lateral, than upward. Some counted the pulses distinctly, to the number of four : that the second, and third pulses were stronger, than the first, and fourth.

From all these various accounts, there was no sulphureous smell, or eruption; no fissures in the ground perceived. Yet several people were sick upon it : infinite numbers terribly affrighted, and as soon forgot the impression of it; or talk'd of it in a merry strain; as commonly with us at *London*. So little are the vulgar affected, without something very sensible; and so soon is the sense of it worn out!

It was more evidently perceived, by people standing; most, by those that were sitting: least, by such as were walking: and in upper stories of houses, more than in lower; or in cellars. Some coming down stairs, were in danger of being thrown forwards. Several sitting in a chair, and hearing the hollow thundering noise, and thinking it was a coach passing by; when they attempted to get up, to see what it was, they were thrown back again in their chair. Some heard the wainscot crackle. Some sitting in their chairs leaning forwards, were thrown down on their hands and knees. Some people heard the noise without feeling the shock : others felt the shock without hearing

ing



ing the noise. Some in a standing posture, were forced to lay hold on a table, to keep themselves from falling.

It was particularly remarked (as before observed) that birds in cages were sensibly affrighted; thrusting their heads under their wings. Mrs. *Allicock* of *Loddington, Northamptonshire*, a lady in child-bed, was so affected, that it caused her death. Mrs. *Hardy*, another lady in the same circumstance, and in the same county, likewise expired upon it. Some people felt a sudden shortness of breath, that they were forc'd to go out into the open air, it so affected the pulmonary nerves. Many were taken with head-achs, and other sicknesses.

These are, in general, the circumstances and observations made, at the time of these earthquakes; when we recollect ourselves, after the suddenness, and fright. Give me leave to make the following remarks therefrom.

1st. As far as we can possibly learn, where no one can be prepar'd, at different places, by time keepers; this mighty concussion was felt precisely at the same instant of time; being about half an hour after twelve at noon. This, I presume, cannot be accounted for, by any natural power, but by that of an electrical vibration; which, we know, acts instantaneously.

2dly,

2dly, Let us reflect on the vast extent of this trembling, 100 miles in length, 40 in breadth, which amounts to 4000 square miles in surface. That this should be put into such an agitation, in one moment of time, is such a prodigy; as we should never believe, or conceive, did we not know it to be fact, from our own senses. But if we look for a solution of it, we cannot think, any natural power is equal to it, but that of electricity; which acknowledges no sensible transition of time; no bounds.

3ly, We observe the vulgar solution of subterraneous eruptions receives no countenance, from all that was seen, or felt, during these earthquakes. It would be very hard to imagine, how any such thing could so suddenly, and instantaneously operate, thro' this vast space; and *that* in so similar, and tender a manner over the whole, thro' so great a variety, as well as extent of country; as to do no mischief. A philosophical inquirer in *Northamptonshire*, who had his eye particularly on this point, takes notice, there were not any fissures in the ground; any sulphureous smells, or eruptions any where perceiv'd; so as to favour internal convulsions of the earth. The reverend Mr. *Nixon* of *Higham*, and Mr. *Smith*, in his letter from *Peterborough* take notice, that they could not learn, there were any sort of eruptions out of the  
earth,

earth, any where: no smoke, vapor, or smell: tho' they made sufficient inquiry about that circumstance, according to particular direction. Yet we learn from a letter at *Uppingham* in *Rutland*, that a plaister floor became crack'd thereby. These kind of floors are frequent in this country; what we call *stucco* in *London*: and it gives us a good notion of the undulatory vibration, produc'd by an earthquake; which some have compar'd to that of a musical string: others to that of a dog, or a horse shaking themselves, when they come out of the water. This last comparison would have pleas'd some of the ancients, who would needs fancy, that the globe of the earth was a great animal. *Plato*, *Plutarch*, and others, had such kind of sentiments. Whence one may imagine, that they would conceive an earthquake to be, as when a horse shakes a part of his skin, upon a fly touching him. Some of our correspondents express the motion of an earthquake to be like a boat lifted up by one wave, let down by another.

4ly, The former earthquake that happen'd at *Grantham*, *Spalding*, *Stamford*, (which towns lie in a triangle) took up a space which may, in gross, be accounted a circle of 30 miles diameter: the center of which is that great morass, called *Deeping-fen*. This comprehends 15 miles of that 30, in diameter: and where probably,



bably, the electrical impressi<sup>o</sup>n was first made. Much the major part of *Deeping-fen* is under water in the winter time; underneath 'tis a perfect bog. Now it is very obvious, how little favorable such ground is, for subterraneous fires.

In the second earthquake, not only this country was affected again, but likewise a much larger space of the same sort of fenny ground, rather worse than the former: all *Donnington-fen*, *Deeping-fen*, *Croyland-fen*, *Thorney-fen*, *Whitlesea-fen*, and *Bedford level*, and the whole extent of *Ely-fen*, under various denominations. This country, under the turf, abounds with subterraneous timber of all sorts; fir, oak and brush-wood: and stags horns. Now and then they find a quantity of hazel nuts, crouded together on an heap. I have some of them. This is a matter common to all boggy ground over the whole globe. Such things are the ruins of the *antediluvian* world, washed down from the high country where they grew, were here lodg'd upon the subsiding of the waters, and by time are o'ergrown with the present turf. They that seek for any other solution of this affair, than the universal *Noachian* deluge, want to account for a general effect, by a partial cause: and shut their eyes, both to the plain history of this matter; and to the infinite, notorious demonstrations of it, from fossil appearances.

sly, All this country, tho' underneath 'tis a watry bog, yet thro' this whole summer, and autumnal season (as they can have no natural springs in such a level) the drought has been so great on the superficies, that the inhabitants were obliged every day, to drive their cattle several miles, for watering. The drought was greater, than has been known in the memory of any one living. This shows how fit the dry surface was, for an electrical vibration. And we learn from hence, this important particular, that it reaches but very little below the earth's surface.

Mr. *Johnson*, in another letter which he wrote to me concerning the second earthquake observed at *Spalding*; says upon this occasion, he was obliged to scour his canal, and deepen it: that they came to a white quicksand; which afforded to all the neighbourhood, excellent water in plenty.

In the gravelly foil of *London*; and where the two shocks were felt by us, in the beginning of the year; we know there is not a house in the whole extent of this vast city, and all around it, but a spring of water is ready, upon digging a well. Whence we have much reason to believe, that the interior of the earth, is like a sponge soak'd in water. So that the only dry part is the superficies, which is the  
object,

object, and the subject of that electric vibration; wherein, according to my sentiments, an earthquake consists.

This shews the mistake of the ancients, who fancying that earthquakes proceeded from subteraneous eruptions, built their prodigious temple of *Diana* at *Ephesus*, upon a boggy ground, to prevent such a disaster. The marshy part of *Lincolnshire*, being my native country, the adjacent fen, together with that of the isle of *Ely*, I have been perfectly acquainted with; from one end to the other, ever since I knew any thing. This vast extent of fenny level, from near *Cambridge* in the south, to near *Horn-castle* in the north, is 70 miles in length. And when I perceiv'd, that it was, in whole, or in part, shaken by both the last earthquakes: I could not but see, that it was no less than a demonstration against the old notion of their cause.

6ly, Earthquakes are truly most violent in a rocky country: because the shock is proportionate to the solidity of the matter electrify'd. So that rocks, cliffs, quarries, old castle walls, and strong buildings, are most obnoxious to the concussion. The isle of *Cerigo* was more liable, and more rudely handled by the late earthquake; both because it was an isle, and because it was rocky. So we must say of the



late earthquake in *Switzerland*, that split the mountain, and the old castle wall. Whence Mr. *Johnson* in his second letter says, it crack'd a very strong brick-house in *Gosberton* by *Spalding*. Dr. *Doderidge* observes from *Northampton*, that Dr. *Stonehouse's* dwelling being a very strong one, was most sensibly shaken. And throughout the whole compass of this great earthquake, we find, both the noise, the shock, and the terror was greatest at the churches, whose walls and bulk made more resistance than houses. And generally speaking, the churches throughout this whole extent have very fair and large towers, and very many remarkable spires all of good stone, which no doubt quivered very much at top, if we could have discern'd it. This same vibration impressed on the water, meeting with the solid of the bottom of ships, and lighters, gives that thump felt thereon; just as in common electrifying, we feel the stroke upon the joints of our limbs chiefly. Yet of the millions of ordinary houses, over which it passed, not one fell. A consideration which sufficiently points out to us, what sort of a motion this was not, what sort of a motion it was, and whence derived; not a convulsion of the bowels of the earth, but an uniform vibration or undulation of its surface, aptly thought like that of a musical

fical string: or what we put a drinking glass into, by rubbing one's finger over the edge; which yet brought to a certain pitch, breaks the glass; undoubtedly an electric repulsion of parts. And from this remarkable similitude in the appearance of earthquakes we gather an invincible argument against the old opinion of their cause; for the tumult of subterraneous eruptions can have no possible place herein.

7ly, We find from all accounts, ancient and modern, that the weather preceding these shocks, was mild, warm, dry, serene, clear, frosty: what notoriously favours all our electrical experiments. This is particularly observ'd by Mr. *Johnson* and Mr. *Smith*; and other accounts. In the extensive shock of *Sunday March 18*, along the *Sussex* coast, they take notice from *Portsmouth*, that the day was serene, warm, and dry, and that a shower of rain fell immediately before the shock. Mr. *Bowman* of *Moulsey* observ'd a shock there on *May 24* last, and says, the air was perfectly serene, and clear. We very well know, that generally, all last winter, spring, summer, and autumn, have been most remarkably of this kind of weather; more so, than has been observ'd in our memory; and have had all those requisites, appearances, and preparations, that notoriously cause electricity, that promote it, or that are the effects of it.

8ly, We find the blood-red *australis aurora* preceding at *Spalding*, as with us at *London*. At the time of the earthquake at *Manchester* this year, it accompanied it. And this year has been more remarkable than any for fire-balls, storms, wind, thunder, lightnings, and coruscations, almost throughout all *England*. A large ball of fire, with a long fiery tail on *July 22*, that passed over great part of *England* northward. Another seen over *London*, passing from west to east, in *october*. Coruscations were seen just before that extensive shock of 70 miles long felt from *Lancaster* to *Wrexham*, on *april 2*, last. Fire-balls more than one were seen in *Rutland*, and *Lincolnshire*: and particularly observ'd. And Mr. *Smith* from *Peterborough* writes, that a fire-ball was seen the morning of the earthquake, in the upper part of *Northamptonshire*. All these kind of meteors are rightly judg'd to proceed from a state of electricity in the earth and atmosphere: and how far they are actually concerned in causing earthquakes, time, and accurate observation must inform us.

9ly, Mr. *Johnson* in both his letters to me, on the first and second earthquakes, at *Spalding*, remarks particularly, of their effects being mostly spread to the north and south, and especially felt on the sea coast. We may observe,



serve, that such is the direction of *Spalding* river, which both conducts, and strengthens the electric vibration: conveying it along the sea-shore thence, up to *Boston* channel; and so up *Boston* river to *Lincoln*, as we discern, by casting our eye on a map.

We observe further, that the main of this second earthquake display'd its effects along, and between the two rivers, *Wolland* and *Avon*: and that from their very origins, down to their fall into the sea. It likewise reach'd the river *Witham*, which directed the electric stream that way too, to *Lincoln*. For which reason, as there meeting the same coming from *Boston*, the shock was most sensibly felt. It reach'd likewise to the *Trent* at *Nottingham*, which convey'd it to *Newark*.

The first electrical stroke seems to have been made on the high ground above *Deventry*, in *Northamptonshire*; where the *Roman* camps are, made by *P. Ostorius* the proprætor. From thence it descended chiefly eastward, and along the river *Welland*, from *Harborough* to *Stamford*, *Spalding*, the sea: and along the river *Avon*, or *Nen*, to *Northampton*, *Peterborough*, *Wisbech* to the sea. It spread itself all over the vast level of the isle of *Ely*; further'd by very many canals, and rivers, natural, and artificial, made for drainage. It was still conducted

eastward up *Mildenhall* river, in *Suffolk*, to *Bury*, and the parts adjacent. All this affair duly consider'd, is a confirmation of the doctrine I advanc'd on this subject.

I only, I apprehend, it was not the noise in the air, as of many cannon let off at once, preceding the earthquake, that so much affrighted people, or affected the sheep, the rookery at *Kensington*, the hen and chickens in *Gray's-inn-lane*, the pigeons. It could not be barely the superficial movement of the earth, that disturb'd them all at once. I judge it to be the effect of electricity, somewhat like what causes sea sickness; such a sort of motion, as we are not accustomed to. So the earthquake affects all those of weak nerves, or that have nervous complaints; obnoxious to hysterics, colics, rheumatic pains in their joints; several women were seized with violent head-achs, before both the shocks we felt in *London*. It was this that gave the people a shortness of breath. Mr. *Smith* from *Peterborough* speaks of a person that found himself very sick upon it. This made the dog run whining about the room, seeking to get out: this made the fishes leap up in the pond at *Southwark*; like as the experiment of electrifying the fishes: it makes them sick. And this causes the birds in cages to hide their heads under their wings, because they cannot

cannot fly away. Which is commonly observ'd of them in *Italy*, and countries, where earthquakes are more frequent.

Truly, I observe, the shepherd at *Kensington* thought the motion of the earthquake, and the sound, was from the north-west to south-east: the like Mr. *W. Smith* from *Peterborough*. On the contrary, Mr. *Byfield* the scarlet-dyer in *Southwark*, thought the noise came from the river below bridge, and went toward *Westminster*; where it rattled so, that he did not doubt, but that the abbey church was beaten down.

Dr. *Parsons* took pains to find out the way of the motion of the earthquake, from the different position of people's beds; but from the contradictory answers given, he cou'd not obtain any satisfaction, as to that point. All this, and what was observ'd from *Northampton*, of the motion being thought by some, to be upward and downward; by others rather horizontal, or lateral: the counting the pulses, and the like, only points out to us the prodigious celerity, and the vibratory species of the motion of an earthquake. But far, very far is this from being owing to the tumultuous ebullition, the irregular hurry of subterraneous explosions.

Truly,



12ly, How the atmosphere, and earth, are put into that electric and vibratory state, which prepares them to give, or receive the snap, and the shock, which we call an earthquake; what it is, that immediately produces it, we cannot say; any more than we can define, what is the cause of magnetism, or of gravitation; or how muscular motion is perform'd, or a thousand other secrets in nature.

We seem to know, that the author of the world has disseminated ethereal fire, thro' all matter, by which these great operations are brought about. This is the subtil fluid of Sir *Isaac Newton*, pervading all things; the occult fire diffused thro' the universe, according to *Marsilius Ficinus* the platonic philosopher, on the *Timeus* of his master. All the Platonists insist on an occult fire passing thro', and agitating all substance, by its vigorous and expansive motion.

Before them, *Hippocrates* writes in the same sense, *I. de victus ratione*, that this fire moves all in all. This ethereal fire is one of the four elements of the ancients. It lies latent, and dispersed thro' all the other three, and quiescent: till collected into a quantity, that overbalances the circumjacent; like the air crouded into a tempest: or till it is excited, by any proper motion.

This

This fire gives elasticity : and elasticity or vibration is the mother of electricity. We don't so much wonder at phosphorus arising from animal substances ; for this fire is in water, and betrays itself to our senses, in salt water. Many a time when I have passed the *Lincolnshire* washes, in the night time ; the horse has seem'd to tread in liquid flames. The same appearance is oft at the keel of a ship. Fire exists in water, says *Pliny*, as well as in human bodies. *nat. hist.* II. 107. Loaf sugar beaten in the dark is luminous. Many vegetables, as indian cane, and rotten wood the like, as *Bartholin* largely recites, *de luce hominum* c. 4. All electric bodies have this privilege : that is, they more easily discover it. Amber, gum lac, naptha, bitumens, some precious stones. My old friend Mr. *Stephen Gray* the father and great propagator of electricity, show'd me experiments therein, in the year 1705, then at *Corpus Christi* college in *Cambridge*. Afterward in 1719, he show'd by experiments before the Royal Society, that paper, ribbands, silk, satin, cloth, shavings, linen, goldbeaters skin, and in short, almost all kind of substances discover electrical sparks of fire in the dark : especially when well warm'd before the fire, or in a cold, dry, nitrous air, and in a room where there is no company. This same quality

lity is found *in vacuo*, as Dr. *Desaguliers* shew'd before the Royal Society, *march* 31, 1720. He took an exhausted glass globe, and caused it to be turn'd round violently, in an engine: by rubbing the hand upon it, it was illuminated within side, with purple streams. This gave foreigners the idea of using a glass globe, in electrical experiments,

The operation of the ethereal fire is various, nay, infinite, according to its quantity, and degree of incitement, progress, hindrance, or furtherance. One degree keeps water fluid, says the learned bishop of *Cloyne*: another turns it into elastic air, and air itself seems nothing else, but vapors, and exhalations render'd elastic, by this fire.

This same fire permeates, and dwells in all bodies; even diamond, flint and steel. Its particles attract with the greatest force, when approximated. Again, when united, they fly asunder, with the greatest force, and celerity; it resists nothing quiescent, but when put into motion, it disdains all resistance. All this is according to the laws prescrib'd by the sovereign architect. This is the life and soul of action, and reaction, in the universe. Thus has the great author provided against the native sluggishness of matter! light, or fire in animals, is what we call the animal spirits; and is the author



thor of life, and motion. But we know not the immediate mode of muscular motion ; any more than how, in inanimate matter, it causes the vibrations of an earthquake.

Of this fire, the excellent *Manilius* thus writes, who liv'd in the time of *Augustus*.

*Astronom. I.*

*Sunt autem cunctis permixti partibus ignes ;  
Qui gravidas habitant fabricantes fulmina nubes :  
Et penetrant terras, Ætnamq; imitantur Olympo :  
Et calidas reddunt ipsis in fontibus undas.  
Ac silice in duro, viridiq; in cortice sedem  
Inveniunt ; cum silva sibi collisa crematur.  
Ignibus usq; adeo natura est omnis abundans !*

Which may thus be english'd.

Fire universal nature traverses.  
It makes the thunderbolt in tumid clouds :  
In dire Vulcano's penetrates the earth :  
And sends the boiling water from its springs.  
In hardest flint, and softest wood it dwells :  
Which by collision shows itself in flame.  
With fire so pregnant is all nature found !

13ly, The great question then with us, is how the surface of the earth is put into that vibratory and electric state, by heat and dryness ? we must needs acquit the internal of the earth from the charge of these superficial concussions.

cussions. How then is the ethereal fire croud-  
ed together, or excited, so as to cause them;  
seeing in our ordinary electrical experiments,  
we make use of friction?

But that friction alone does not excite elec-  
tricity, we know from the obvious experiment  
of flint and steel, where the suddenness of the  
stroke, and hardness of the matter does it.  
Another method of exciting it, is the letting off  
a number of great guns, which so crouds the  
ethereal fire together, as to electrify glass win-  
dows; observ'd by my friend the reverend Dr.  
*Stephen Hales*. The *aurora borealis, australis*, all  
kind of coruscations, meteors, lightning, thun-  
der, fire-balls are the effects, and may reciprocal-  
ly be the cause of electricity; but how in particu-  
lar we know not. Come we to the animal world,  
we must needs assert, that all motion voluntary,  
involuntary, generation, even life itself: all the  
operations of the vegetable kingdom, and an in-  
finity more of nature's works, are owing to the  
activity of this electric fire, the very soul of the  
material world. And in my opinion, 'tis this  
alone, that solves the famous question, so much  
agitated with the writers in medicine, about the  
heat of the blood. How these, how earth-  
quakes are begun, propagated, we are yet to  
seek.

We

We may readily enough presume, that the contact between the electric, and the non-electric, which gives the snap, and the shock, must come from without, from the atmosphere. Perhaps by some meteor that crouds the ethereal fire together: which then flies off with that immense force that causes the earthquake. In the point of contact on the earth's surface, the same thing is done, perhaps, another time, by a shower of rain. Our thoughts upon this matter must needs be as immature, as they are novel. But we may readily conclude, that tho' the original stroke comes from the atmosphere, yet the atmosphere has no further concern in it: no aerial power, or change therein, can propagate itself so instantaneously, over so vast a surface, as 4000 miles square. Therefore the impetuous rushing noise in the air, accompanying the shock, is the effect, and not the cause. And all this is strongly confirmed by this observation, that the barometer and thermometer received no change upon the earthquakes.

But surely, there is not a heart of flesh that is not affected with so stupendous a concussion! let a man estimate his own power, with that which causes an earthquake; and he will be persuaded, that somewhat more than ordinary  
is



is intended by so rare and wonderful a motion. That great genius *Hippocrates*, makes the whole of the animal œconomy to be administered, by what we call nature. And nature alone, says he, suffices for all things, to animals: she *knows* herself, and what is necessary for them. We must extend this thought to the inanimate world. And can we deny then, that he here means a conscious and intelligent nature, that presides over, and directs all things, moves the æthereal spirit or fire, that moves all things: a divine necessity, but a voluntary agent, who gives the commanding nod, to what we commonly call nature; the chief instrument in the most important operations of the vast machine, as well as in the ordinary ones, particularly the human one: administering the whole œconomy (as he says) without noise, unseen, unfelt. And this leads us,

14ly, Lastly, in regard to the spiritual use we ought to make of these extraordinary *phœnomena*, or of our inquiries about them, I shall first observe, that we find abroad, several of these earthquakes this year have been very fatal. In the last we read of, at *Philippopoli* in *Thrace*, the whole city was destroyed, above 4000 inhabitants killed. At home, where above half a score separate concussions have been felt, there

there has not been one house thrown down, one life lost. This ought to inspire us with a very serious reflection about them; nor is it altogether unworthy of our remark, that they began with us in *London*, in *February* last: and after visiting the circle of the globe, at present, end with us.

2dly, We may observe, that if we did but read the works of *Hippocrates*, *Plato* and his followers; of *Tully*, *Galen*, and the like ethic writers of antiquity; whilst we study, and try the affections of matter; we should improve in philosophy, properly speaking: we should lift up our minds from these earthly wonders, and discern the celestial admonitions, they present to us.

The original meaning of the word philosophy, was rightly apply'd to moral wisdom. We who have advanced both the natural, and moral, should, as the ancients did, join them both together. By this means, we gather, the truth of the highest, and most excellent philosophy, to be found in those volumes of first antiquity, which we call sacred: and which, it is our peculiar, and inestimable happiness to possess. We should adore that divine light, which they hold forth to us. Especially in a country, where the principles of true religion

are open, and undisguised: where the established profession of it is rational, noble, and lovely: worthy of the moral governor of the world; fit for him to enjoin: for us to practise, with pleasure and effect.

*November 7, 1750.*

**W. STUKELEY.**

*Read at the Royal Society, December 6.*





THE  
PHILOSOPHY  
OF  
EARTHQUAKES,  
NATURAL and RELIGIOUS.

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PART III.

---

*Opinionum commenta delet dies, naturæ judicia confirmat.* Cic.

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By WILLIAM STUKELEY, M.D.  
Rector of St. George's, Queen-Square; Fellow  
of the College of Physicians, and of the Royal  
and Antiquarian Societies.

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LONDON:

Printed for A. and C. CORBETT, at their *Correct*  
*State Lottery-Office* over-against St. Dunstan's  
Church, Fleetstreet.

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M.DCC.LVI.

THE  
PHILOSOPHY  
OF  
EARTHQUAKES  
NATURAL and RELIGIOUS.

PART III.



By WILLIAM STURKELEE M.D.  
Rector of St. George's, Great-street; Fellow  
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Church, Westgate.

M.DCC.LVI.

To the Right Honourable

The Earl of MACCLESFIELD,

President of the Royal Society.

THE amazing *phænomemon* of November 1, 1755, being *All Saints* day, will prove a most memorable point in the current of time, as long as the revolution of our globe, measures it. This has induced me again to treat on the subject; a regard due to so remarkable events in our own days, our own country, among others.

Though the mere history thereof merits to be recorded, and somewhat of their manner; as far as they seem to lead us to the philosophy of these prodigious movements of nature: yet I was more particularly induced thereto, when I could not help perceiving, that they all pointed out the cause, which I had assigned, five years ago.

I have been attentive to this argument, upon every occasion that has offered from home, or abroad; and this last of 1 *November*, has in every circumstance so confirm'd it, that I hope, it will not be unseasonable to add this third part



to my former. We cannot treat on this awful subject, without a regard to religion, never to be separated from so extraordinary a power in nature. A power wherein all the four elements are engaged; not in a mutual opposition, and friendly strife; for in that elemental combination, the operations of nature in their usual course are carried on: but in a concurrence tumultuous, an engagement absolutely hostile.

These unbridled storms require the hand of providence to overrule them, to rebate, to direct. And this before us appears to be one of the greatest commemorated in history, like to that of *Tiberius's* time, when 13 noble cities of *Asia minor* were totally destroyed, as now *Lisbon*, *St. Ubes*, and some more. They were not swallowed up, according to the vulgar notion, and the vulgar way of expression, on these occasions, but shaken into an heap of rubbish, as now *Lisbon*, &c. They were rebuilt on the same foundations; this happened ten years before our Saviour's baptism, and entry on his public ministry. There appeared several more of these tremors, in the *Roman* empire, about this time; but *Asia minor* was a very conspicuous point, and prov'd a most fruitful seed-plot of the christian church in its infancy, where were the seven flourishing churches, to which *St. John* addresses the apocalypse. A judgment  
this

this very proper to reduce the inhabitants to such a serious frame of mind, as is agreeable to the views of religion. And we may observe, the prophets often speak of such, as preludes to the advent of Messiah. Thus *Isaiab* xiii. 6. “*Howl ye, the day of the Lord is at hand, it shall come, as a destruction from the Almighty.*” 12. “*Therefore I will shake the heavens and the earth,*” &c.” repeated in *Joel* iii. 14. very remarkably. *Haggai* ii. 6, 7.

And these kind of portents, at all times are seasonable, to recal Christians from the riotous excesses, and love of pleasure, which is the general source of the evils in this state of things; that want to be corrected, that dissipate all reflection, promote a neglect of that soul of religion; the sabbatic duty, that corrupt the morals of mankind, and prevent the good example, which the great ones ought to hold forth, to the inferior part of the world: without which, all advice, and instruction is fruitless.

Hence it is, that Christianity, intended, and incomparably well suited, to make us happy here, as well as hereafter; to render the world even a kind of paradise, is defeated in its purpose. For did we intimately consider the matter, it is *that* alone, which gives true felicity in human affairs, even in our present state.

In my first paper on this subject, I recited the general appearances of earthquakes, in the form of axioms; as very helpful in the investigation of causes. Its now useful to repeat them, and from later observations somewhat improved, and enlarged, thus:

#### CIRCUMSTANCES.

I. That earthquakes always happen in calm, warm, dry, sultry seasons; or in a dry, frosty air.

II. That they are felt at sea, on lakes, rivers, even in the main ocean, as well as on land: and at that time the sea and waters are calm.

III. That earthquakes differ very much in magnitude. Some shake a very large tract of country, at the same instant of time: sometime extend to many countries, separated by mountains, lakes, seas, the ocean.

IV. That earthquakes differ much in the quantity of their vibratory motion; whence in some, though largely extended, they are innocuous: in others, both small and large, they lay all in ruins.

V. That a hollow thundering noise accompanies them, or rather seems to precede the shock; which rolls in the air, like the noise of cannon.

VI. That



VI. That they are felt more sensibly in the upper story of houses, than in the lower; on lofty buildings, steeples, *Turkish* minarets, and the like.

VII. That the shock is more violent upon more solid buildings, churches, castles, towers, and stone-houses, than on those of slighter materials.

VIII. That many people find themselves sick at stomach, with head-achs, *vertigo's*, pains in their joints, and the like: which sometimes last for the day after, or longer.

IX. That earthquakes generally happen to great towns, and cities: and more particularly to those that are situate on the sea, bays, and great rivers.

X. That earthquakes do not cause any damage to springs, and fountains: but the water in wells becomes foul for some time.

XI. That they are frequent in the neighbourhood of a vulcano.

XII. That earthquakes often shake rocks, mountains, cliffs hanging over the sea, split them from top to bottom, throw down great parcels of them.

XIII. That fowls domestic, birds in the air, cattle in the fields are affrighted, fishes in the water much affected therewith.

XIV. That chandeliers in churches vibrate; bells in steeples and houses ring.

XV. That sometime, the hollow, thundering noise accompanying an earthquake, is heard without any motion on the earth.

XVI. That an impression or agitation in the water, is sometime perceiv'd, without a motion on the earth: at other times accompanies it.

XVII. That fire balls and meteors are frequently observ'd then.

XVIII. That the surface of the earth is chiefly, and most frequently, the object of earthquakes.

XIX. That earthquakes affect to run up rivers and sea-shores, and act more violently on places neighbouring thereto.

A due reflection on these particulars must lead us to the real cause, electricity, no other than what causes thunder and lightning, meteors, coruscations, *aurora's*, and the like aerial appearances.

The ensuing paper I had drawn up in part, to be laid before the Royal Society, but was continually interrupted by new accounts every post. From the whole I extracted what was chiefly requisite for the purpose of illustrating our main doctrine.

Being

Being at *Stamford*, in the beginning of *August* last, I heard from all hands, of the earthquake perceived there, and round the country; on *Friday* the first of that month, at seven in the morning.

They did not scruple there, calling it an earthquake: though no movement on the earth was observed, only the horrible noise above head, always accompanying an earthquake.

After my return to town, I received a letter from our ingenious correspondent Mr. *Thomas Barker*, of *Lyndon* in *Rutland*, giving a very precise rehearsal of what he observed therein. Whilst I was transcribing the particulars, in order to lay them before the Society, we have had such numerous, and continually repeated accounts of these dire disasters, well nigh thro' all *Europe*, happening this year, that I could not avoid making mention of them all. But as these bare relations may be accounted only matter of history, I shall speak somewhat of their cause, and their diversities; which is more properly the business of the Society: yet with conciseness; because my sentiments concerning them, have been already delivered in print.

Mr. *Barker* writes, that about 40 minutes after 6 o'clock in the morning of that first of *August*; standing against a north window, he heard a

con-



continual rumbling noise, like a long clap of thunder, as if about four miles off.

At first he thought it such, but as not a cloud was to be seen, the sky being perfectly clear, he could not conceive, that it should be thunder.

Then he took it for a wheelbarrow, rattling over the stones, just under his window. Others in the house heard it, and fancied, something was fallen down, and rolling about, above stairs. Others in the village supposed it to be the rattling of a coach, or a cannon let off; or the shooting down stones out of a cart, or the like.

Many describ'd it with a great thump (so they term'd it) accompanied with the rumbling. Some said it was louder than any thunder they ever heard: and that cattle in the fields were much affrighted at it. All agree the noise lasted some few minutes. Some say they heard a great thump again.

It is reported, that a ball of fire was seen just before; and a great flash of lightning.

Mr. *Barker* says, that immediately going abroad, he saw low in the northwest, a faint white hazyness in the sky; the rest of the heavens quite clear. Yet an hour after, many scatter'd clouds appeared from that quarter, the wind being from thence: so that the day was  
lowering,

lowering, yet fair and windy, till the evening. Then a slight shower fell. But the weather had been moist and showery before. And after this, it rained every day, more or less, for some time. The barometer was now 29. 6. beginning to fall.

Some discerned no concussion in the earth: others declare positively, that the ground shook under them. One walking between *Ketton* and *Tinwell* in *Rutland*, said; the concussion was violent. But the noise was heard all over this county of *Rutland*: as also at, and beyond *Stamford*, *Grantham*, *Lincoln*, *Melton-Mowbray*, *Waltham*, *Leicester*, *Nottingham*, *Kettering* and *Rushden* in *Northamptonshire*. They say, at *Lincoln*, it was repeated again, at 12 at night.

But a concussion was felt in the morning, and the noise very loud, upon the hill country to the north of *Lincoln*; between the rivers *Trent*, and *Ankam*. So that they concluded, many cannon were fired at *Hull*. Some supposed many horses at waggons, were all together running away, down the steep hills, from the Heath. It actually shook many houses, and the walls of some fell down, about *Frodingham*, *Burringham*, *Lodington*, and *Adingfleet* near the *Humber*. Some houses shook so, and trembled, that the walls seemed as though they would meet.

I re-

I received likewise a letter from *Thomas Whichcot* Esq; knight in parliament for the county of *Lincoln*, intimating, that all the parts of that country were sensible of it: both by their eyes and ears; from the motion felt, and from the explosion, or noise accompanying. He adds, upon reflection, he has the greatest reason in the world, to judge, its cause to be aerial.

Assuredly, we may make this observation upon what has been said; that the horrible noise heard around so large a space of country, and which always accompanies an earthquake, must not acknowledge any subterraneous origin; and can be no other than an electrical shock, a stroke in the atmosphere, the same as makes thunder. That the concussion of the earth being but partial plainly intimates, there was not an universal propensity in the earth's surface, to receive the shock; it was not in a proper degree of electricity. And this we might well expect, from the moist state it must needs be in, when the whole year round, the weather has been rainy, to an extraordinary degree.

Whilst I was writing this, a letter appeared in the *Public Advertiser*, for *Monday* the 10th of *November*, from a gentleman in *Yorkshire*; giving a circumstantial account of that earthquake, which happened on *March* the 25th last,



last, at *Black Hameldon, Yorkshire*, near the place famous for the annual horse-races, and held there in autumn, with a vast concourse of people.

I judge this anniversary meeting to be a continuation of the solemn *panegyres*, or quarterly assemblies of the Druids, for a publick sacrifice; which were always accompanied with sports and horse-races.

At the neighbouring *Ofmotherly* on the same hill, is another great meeting held to this day, with horse-races at the summer solstice; called still the Midsummer-games; a like remain of the Druids. And there are some ecclesiastical privileges now subsisting at the church.

We had a letter concerning that earthquake, read at the Society, on *May-day* last, from a gentleman at *Ellenthorp*.

The writer of the 10th of *November* last says it began with a vast thundering, which affrighted the horses and cattle. That the surface of the earth rose and fell, like ridge and furrow, in plowing; *i. e.* in waves, or vibrations: though he had the common wrong notions of subterraneous explosions, fires from *pyrites*, and the like fancies.

He describes it further, as a great roaring noise, like many cannon let off; or loud and rolling thunder. It seemed to come from a  
great

great ridge of the cliff, on the south-west of *Hameldon* hill; particularly from that part called, *Whiston-cliff*, which I take to mean *White-stone*. It is a vast and high rock, white in colour, and conspicuous all the country round, to a considerable distance. It is of no consequence to recite the descriptions and various appearances, which these writers give us, from antiquated apprehensions, of the cause of these *phænomena*: but in substance, it is certain, that a vast portion of the solid rock was struck down, by the electrical shock, from top to bottom of the cliff.

This was done in a perpendicular line, as if cut smooth with tools of a mason. It is described to be fifteen yards thick, thirty high, above sixty broad. This was thrown down into the valley, split into many pieces; some of which were cast to the distance of five or six hundred yards.

Our writer then reasons upon the subject. Was it effected, says he, by “ a merely natural  
 “ cause, if so, that cause must have been either  
 “ fire, or water, or air. It could not be fire,  
 “ for then some marks of it must have appear-  
 “ ed, either at the time, or after. But no such  
 “ mark does appear, nor ever did: not so  
 “ much as the least smoke, first, or last. It  
 “ could not be water, continues he, no water  
 “ issued

“ issued out, when the rock was torn off. Nor  
 “ had there been any rain before : In that part  
 “ of the country, a remarkable dry season.  
 “ Nor was there any cavity in that part of the  
 “ rock, wherein a sufficient quantity of water  
 “ might lodge. He concludes, there remains  
 “ no other cause, but imprison’d air, which he  
 “ acknowledges equally insufficient for produ-  
 “ cing the effect.”

At length he makes it merely supernatural.  
 But though we allow it to be the effect of a di-  
 vine hand, yet that hand can work sufficiently by  
 means of the power of the electric stroke of the  
 elemental fire, spread through all nature. And  
 that hand can direct the stroke, both as to place  
 and time, as best suits the purpose of a celestial  
 monition : where there is so great a concourse  
 of the nobility and gentry every year, according  
 to our writer’s hint. “ This is wrought, says he,  
 “ in such a manner, that the *many* may see it  
 “ and fear : And travelling along one of the  
 “ most frequented roads in *England* ; who must  
 “ see it, whether they will or no, for many  
 “ miles together.

“ Further, it must, for many years, maugre  
 “ all the art of man, be a visible monument of  
 “ God’s power.”

These and the like are this Gentleman’s just  
 and pious sentiments as to the moral purpose of

B

these



these wonderful appearances. And it is very obvious to inforce the same sentiments, from the many like, and much more dreadful earthquakes since, which this year, fruitful in those natural prodigies, has afforded us all over *Europe*.

For we have found them chiefly directed to great cities and towns. So that if we believe Providence is concerned in the government of the world, we cannot help looking on them in the view of celestial monitions.

Indeed, since I set pen to paper, in this memoir, I have been continually interrupted, with more and more of these shocking accounts, every post: which have unavoidably carried it far beyond its intended bounds.

I am much mistaken, if our philosophical solution of the cause, as well as the assigned purpose of earthquakes, will not be strongly corroborated by a bare recital, which we must needs make of them.

On *Saturday* the 24th of *May* last, an earthquake was felt at *Tame*, and *Lillingston* in *Oxfordshire*. The surface of the earth, and houses were much shaken, but no damage done. That same day, I rode from *Oxford* to *Windsor*: Having delivered Mr. *St. Amand's* fine library, which he bequeathed to the *Bodleian*.

*Saturday*

On Saturday the first of November, we had an account in the News Papers, of a strange agitation on the water, in the port and docks of *Portsmouth*: so that some ships rolled fore and aft; others from side to side. But no motion was perceived on the earth. We have lately received a more particular relation of it at the Society. As likewise of the same *Phænomenon* at the same time, between 9. and 10. *Mat.* at *Plymouth*, from Dr. *Huxam*, who judiciously suggests its true cause, an electrical stroke: but this was felt likewise somewhat upon land: as at *Pool*, both on land and water.

Since then, we have had ample accounts both of the agitation on the water and real earthquakes from *Swansey* in *Wales*, from the coasts of *Suffex*, *Surry*, *Kent*, and up the inland parts, *Godalmin*, *Guilford*, *Cranburn*, *Sherburn* castle, *Oxfordshire*, *Luton* in *Bedfordshire*, *Enfield* near us; moreover it was observed at *Peers-Pool*, a large body of water by *St. Luke's* in *Old Street*. It was found too at *Whitehaven*, *Cumberland*; and in *Loch-Lomund* in *Scotland*, *Lochness*, &c.

The same was felt half an hour after nine in the morning at *Cork*, *Ireland*; with a considerable shock of an earthquake. The motions on the surface of the earth, are described to be

short, and tremulous. It was quite confined within the bounds of the town.

The electric stroke was felt on the water only, at *Kinsale*; not the least breath of wind blowing. The water did not rise gradually, but with a hollow and horrid noise, rushed in like a deluge; rose six or seven feet in a minute, and as suddenly subsided. It was as thick as puddle, very black, and stunk insupportably; being stirred up from the bottom of the harbor. Very great damages done to the shipping, which were whirled about like so many corks, and dashed against each other; many were thrown high above land, and there left. It came by fits, at a quarter of an hour's interval; to the infinite amazement of the inhabitants, who feared doomsday was at hand.

Thus fared it with the *Britannic* isles. And reason sufficient have we, to acknowledge the kind indulgence of providence! but since we have been beyond measure alarmed, with this terrible judgment taking its hideous steps, over the continent; and *Africa*, and *East* and *West Indies*: whereof we must note some particulars.

First, we heard of it from *Amsterdam*; the weather calm, as always is observed. The chandeliers in some churches were found to vibrate; which shows a slight motion at least,

on



on the land, as well as on the fluid element. But the agitation there, was felt in many parts of the province; particularly at the *Hague*, *Leyden*, *Gouda*, *Rotterdam*, *Leerdam*, *Henkelem*, &c. It was observed to run up the rivers *Wefer* and *Elbe*. That it is a property of electricity, I have formerly taken notice of. After this, we find it, the same hour, at *Hamburg*, and *Lubec* in *Holstein*. The water in the *Trave* rose four or five feet perpendicular, and subsided alternately, and instantaneously, for a long time. The ships snap'd their cables. Great damage done to the vessels in general. The like notices from *Gluckstad*, and other places thereabouts, accompanied with a real earthquake. It affected the river *Eidar*. The people at *Renfborough* at prayers in the new church, observed three large branches suspended from the roof, vibrated very much, from east to west. They weighed twenty hundred each. That over the baptismal font, not so heavy, not so much affected. The water of the *Stabr* greatly agitated at *Itzeboe*: and a large float of timber was thrown on the bank.

The water surrounding fort *Steinburgh* threatened to overthrow the fort: those of the *Ave* the like, at *Vetersen*. The branches in the church too vibrated at *Emshorn*, *Bramstat*, *Wilsler*, *Kellinghusen*, and *Melidorf*. The Waters

of the *Schwinge* and the *Oost*, greatly agitated, and at *Cuchaven* and other places beyond the *Elbe*.

From *Berlin* they write, the weather being perfectly calm; the agitation in the waters was found in the lakes at *Templin*, *Netzo*, *Mahlgast*, *Rodelin*, and *Libbesc*. The water ebb'd and flow'd six Times in half an hour. The fishermen at *Netzo* said, that it had an insupportable stench; which shews, that the force affects the water, to the bottom of the sea. It was accompanied with a most frightful noise.

It was observed too in *Norway*, at *Dalecarlia*, and some other provinces in *Sweden*. At the same time, the rivers, and lakes were extremely agitated.

The same day and hour we hear of it at *Madrid*, in form of a real earthquake. It shook the *Escorial*, so that the royal family were obliged to abandon it. Several persons were killed by the falling of houses. The people all fled. *St. Andrew's* church was rent in several places.

The shock was felt at *Bilboa*.

At *Oporto*, several houses were quite destroy'd: Some churches and steeples much damaged. By the sudden swelling of the sea, the water run higher up, than any tides had ever reached.

The

The town of *Setuval*, or *St. Ubes*, a flourishing place, quite destroyed, and many ships sunk. The chain of rocks on the west side of the town, which contained the quarries of the fine jasper marble of various colours, so valuable, split and rent.

*Malaga* likewise felt a violent shock of an earthquake. The bells rung in the steeples. The water in a well overflow'd, and as suddenly retir'd again. There it was repeated: and the people were seized with the same foolish panic as with us, five years ago; and totally deserted the city for a whole night.

Great damages done at *Granada*, at *Cordova*, *Anteguera*.

It was violent at *St. Lucar*, and *Sevil*, where the most magnificent cathedral has received much damage. Many persons killed. They look'd on it as the Approach of the day of judgment. The sea swell'd to an amazing height, and enter'd the city, almost destroyed it. Not a single church or convent has escap'd without damage, and few houses. The borough of *Triana*, the villages *St. Juan*, *Dalfarache*, *Gilbes*, *Brines*, *Camas*, and many others in the neighbourhood demolished. The city of *A-reos* likewise.



It passed above 30 leagues along the sea-coast; breaking off large rocks toward the shores, which fell into the sea.

At *Cadiz* the *French* consul lost his life. The sea carry'd away a vast length of the wall, and of the mole: destroy'd the long caufway of two miles, with many people, cattle and carriages upon it, flying from so terrible a calamity.

It was felt in the island of *Chicblana*, at *Medina*, *Port Real*, and *Cheres*.

It was violent in *Faro* in the kingdom of *Algarva*, quite destroyed it; and *Lagos*. Felt at *Silvas*, *Villa-nova*, and all the sea-coast, from cape *St. Vincent*, to the river *Ayamonte*.

The Agitation of the water was strong at *Porta Maria*, at *Salamanca*, *Segovia*; very terrible at *Valentia*, *Coimbra*. The cathedral church, the jesuits magnificent college, the church of holy cross, the dominican monastery of the inquisition, and other great edifices entirely destroyed there. At *Braga* the same.

At *Gibraltar*, the morning was clear, it began with a terrible rumbling noise as usual: then a trembling and violent shock. After a second trembling, another shock. The guns on the batteries plainly rose, and fell, like waves: the earth having an undulatory motion. Several things thrown off the shelves; and the

gable end of two houses rent. Most people seiz'd with giddiness, and sickness, stupified; some fell down. They that were walking, or on horseback, felt no motion, but were sick. In general, all were affected, as if electrify'd, so they themselves express it. The sea much agitated. The ships trembled, and felt a thump at the bottom. The *Dutch* ships off cape *St. Mary's*, fir'd guns of distress, thinking they struck on ground. A large piece of the rock was split off, into the *Catalan* bay.

At *St. Roque* persons tofs'd out of their seats. An arch of the church rent.

At *Algazeist* several walls fell down, and great part of the town overflow'd.

At *Eslapona* the church much damag'd.

Now it pass'd into *Barbary*. At *Arzilla* the water rose nine Feet. At *Tangier* they say 50, perpendicular.

*Mequinez* has suffered much. Two thirds of the inhabitants destroy'd. A great mountain split, whence a torrent of water ran for some days. All the whole coast of *Africa*, with a dozen cities destroy'd. *Algiers*, *Tunis*, *Fez*, *Morocco*, *Salle*, &c.

Return we to *Europe*. The island of *Minorca* was pass'd over. Most of the provinces in *Spain*, felt its fury. But the whole kingdom of *Portugal* was involv'd in a general desolation.

The

The great, the populous, the rich, the splendid metropolis, and royal palace of *Lisbon*, totally destroy'd.

It was felt likewise in *France*. At *Bourdeaux*, both the shock and the agitation of the water. The river *Soane* by *Lyons* overflow'd so suddenly and violently, as to do a great deal of mischief. The like, in other parts of that kingdom.

The whole islands of *Sardinia* and *Corfica*, were shaken; and the waters agitated very much; and by overflowing, done a great deal of mischief.

At *Turin* a severe shock. At *Bazil* in *Switzerland*, and the neighbourhood. The lake of *Zurich* much agitated. Felt at *Strasburgh* and *Stutgard* in *Germany*.

This same earthquake was felt the same time, in the *West-Indies*, in the island of *Barbadoes*.

Further the electric stroke exerted its fury, on the mountains in *Portugal* and *Algarva*, as well as cities; on the largest mountains and ridges of mountains, such as *Estrella*, *Arrabida*, *Marvan*, *Sintra*, *Monte Julio*; they were shaken from the foundations, and most of them open'd at the summits, split and rent, in a wonderful manner, huge masses of them thrown down into the subjacent valleys.

There is no city or place of note in the kingdoms of *Portugal* and *Algarva*, but what have



have suffered more or less: *Villanova, De Portimano, Taveira, Castro Marino, Beja, Elvas, Portalegre, St. Ubes, Cascaes, Sintra, Santanem, Coimbra, Castello Branco, Lamigo, Oporto, Viana, Braga, Guimaraens, Villareal, Braganza, Pinhel*, and others.

It was felt all over *Spain*, except in *Catalonia*, the kingdoms of *Aragon* and *Valentia*.

The rivers particularly subject to its influence, prodigiously swelled, the *Guadiana*, *Minho*, *Douro*. It passed up the *Tagus* for 300 miles, as high as *Toledo*, and did damage all the way, on both sides.

We have many accounts of ships at Sea, in the middle of the great ocean, participating in this amazing *phænomenon*. A very loud thundring Noise begins it, it seems, as if casks were rolling about upon deck. The masts, the whole ship tremble like a reed shaken with the wind. A great thump felt at the bottom of the ship, as if it struck upon a rock. The Compass often overturn'd in the benacle. The earthen ware, bottles, and the like broke. If in the night, flashes of lightning appear, fire-balls. The compass often loses its directive power.

But the tremendous Tragedy of *Lisbon* presents us with a picture of all human woes accumulated. We should shudder at the description,

tion, which therefore I forbear, But the principle of electricity sufficiently display'd itself, nor needs any accurate dilucidation : It began with a terrible, rumbling noise, as usual. The shocks heaved up the most ponderous edifices, and shook them as branches of trees, by the wind. The houses bent, or nodded to and fro, like the masts of ships just mention'd, till they tumbled down ; the upper parts of them first. So the steeples, and towers of churches. The ground and the streets danc'd under their feet, as they fled, like the wire of an equilibrist. They express it by the term of undulation, and trembling. Sometime it was so violent, that they were oblig'd to lie down, or kneel, not able to keep on their feet.

The city of *Lisbon* is founded on a rock of marble ; so much the more susceptible of the electric power, which gave it the vibration. Hence the ruins of churches, palaces, houses, lie upon their foundations, respectively ; as the houses of cards made by children, thrown down by a slight shock of a table. And so we are to understand of all the rest, in other places.

Here they tell us expressly, that there were not any eruptions in the city, fiery, or otherwise. But the fires which caused the consequent conflagrations, proceeded from the lamps in churches, and the culinary fires, in the houses.

houses. Some places were set on fire, by villains, for sake of plunder.

They tell us expressly, there were no chasms in the earth, in or about the city, nor all along the coast.

The ships were likewise much agitated. The air in a perfect calm. The water in the river rose 20 or 30 feet several times.

Beside all these recited, this fruitful year of earthquakes has produc'd many more, in every part of the globe; both before and since the fatal Nov. 1. as at our colonies in *America*, at *New-England*, where it did a great deal of damage to the houses at *Boston*, particularly the upper part of them, and more to the brick buildings, than the timber ones.

At *Philadelphia* on Nov. 20, a smart shock.

At *New-York*, the morning calm, not a breath of wind stirring.

A most furious earthquake happened this year at *Cachan* in *Persia*.

Fresh earthquakes have happen'd in *Holland*, and agitations on the waters: Particularly both at *Leyden* and *Amsterdam*, the water in large vessels for brewing, were sensibly affected.

The like at *Geneva* on Dec. 9, in *Franconia*, the dutchy of *Wirtemberg*, *Suabia*, the *Brisgau*, *Alsace*, most parts of *Swisserland*.

At



At *Milan*, Dec. 9, violent. The water extremely agitated. Great buildings rent. Furniture of private houses thrown down.

From *Maestricht* on the 26th, a shock. At the same time at *Nimeguen*, *Arnheim*, *Venlo*, *Cleves*; in the *Weterau*. Also at *Niewied*, *Bonn*, *Cologne*, *Coblentz*, *Neuss*, *Dusseldorp*, *Juliers*, *Duren*, *Stolberg*, *Stablo*, *Malmedi*, *Spa*, *Verriers*, *Barico*, *Neaux*, *Aix-la-Chapelle*, *Liege*, *Lidt*, *Namur*, *Mons*, *Ath*, *Louvain*, *Molmies*, *Breda*.

On November 17, an earthquake felt about *Whitehaven*, *Cumberland*. A most violent tempest of rain and lightning, at the same time, with us at *London*. Mr. *Barker* writes from *Lyndon*, *Rutland*, that it was a very tempestuous night. Men ringing the bells at *Ridlington* church, beside the wind and rain, heard a most affrighting noise, as if the steeple was tumbling down, which made them all run out of the church. The same noise was heard by others, in their houses, in the same town.

December 18. an earthquake said to to be upon the river *Wye* in *Herefordshire*, attended with a great rumbling noise, to the astonishment of the neighbourhood, who thought the world at an end. A cliff with the trees growing on it, were struck down into the river.

Thus

Thus we have recounted a short, and general view, of this most wonderful, and to many persons and places, fatal effects of this great power of nature, which we call an earthquake: chiefly on that *Nov. 1.* The name of earthquake given by our ancestors was, with much greater propriety, than usually attended to; and which carries evident tokens of its true, and genuine cause.

We have since lost sight of it, by our descriptions deriv'd from a prepossession, in favour of a wrong cause; fiery eruptions, vapors, gaping ground, and the like. Whereas 'tis really a quaking, or *tremor* only of the earth, of the surface of the earth: not like the rending, and explosion of a mine of gunpowder, at the Siege of a town, which tosses up all before it, or above it, men, stones, and earth, into the open air.

We have only recited the places, and chief circumstances, which show its cause: which we are to understand, as a merely superficial vibration: no chasms, sinking of towns, cities, mountains, rivers, or the like fanciful appearances. But historiography is not the only purpose of the Society. We must endeavour to find out the causes of things.

It is indubitably owing to the power of electricity, exerted in the atmosphere; the same as  
makes

makes thunder and lightning. This power subsists in a vibration. The stronger and more solid the matter excited by it, the stronger are the vibrations. Whence cathedrals, churches, palaces, goals, castles, towers, rocks, stone-houses, and firmer kind of buildings suffer most, and first: just as the philosopher some time since, applying a cannon, instead of a lighter conductor, in his electrical experiments, met with his fate, from the violence of the shock.

That these portents of nature always happen in a calm, in dry weather: that the cattle in the fields are affrighted at it; that the prelude is a most horrible noise: that it affects ducks, and geese above water, fishes in the water, fowls in the yard, birds in the air; all shows an aerial cause.

The same is pronounced of the sickness, *vertigo* and the like, seizing men and women, especially of weak constitutions, in childbed, or lately handled with a disease: of which I know several instances, besides those commonly recited: that balls of fire, coruscations accompany: that a quarter of the globe was here affected at the same time, both land, and ocean; *Britain, Ireland, from Norway to Morocco, and Barbadoes Island*: that bells rang in steeples, in houses, chandeliers vibrated in churches: that



that this effective power runs along rivers, sea-shores, touches maritime places chiefly; indeed all its appearances whatsoever consider'd free from old prejudice, effectually discharge subterraneous fires, *pyrites* and *cinnaber*, from blame; and assert the electrical shock, its genuine cause.

They that can fancy such fires running across the solid globe from *Cornwall* under the ocean, to *Barbadoes*, to *Portugal*, *Africa*, *Norway*, like squibs in the air across a street, are not to be argued with.

On the 11th *November* this year, a smart shock of an earthquake at *Philadelphia* in the *West-Indies*. The like at the same time at *New York*. The same in *New England*, at *Boston*.

The same was felt at the same time, at *Norden Syssel* in *Iceland*. A violent shock at *Husewig*, and upon the water. We can acknowledge no other than an aerial cause to touch countries so distant.

From the journal book of the ship, the *Queen of Hungary*, Capt. *Veale*, I received this extract. It lay under the King's palace at *Lisbon*, Nov. 1. last. The weather more serene and calm than usual. About 40 minutes after 9 in the morning the shock began, with a strange and frightful rumbling noise, seeming to descend from the atmosphere. Toward the evening a violent shock

completed the ruin of the city. It was preceded, and attended by most terrible lightnings.

And a great ball of red fire, in appearance as big as the sun, was seen.

These were now visible, as being in the night: when in the day time, invisible.

In so surprizing an effect as an earthquake, and so unaccountable a cause as electricity, a cause but recently considered, or known, is it to be wondered at, if some difficulties occur? can we yet pretend to unriddle all the secrets of electricity; though we know some: and in my apprehension are sufficiently clear, as to the efficient before us?

Some objections there are, not insuperable. For instance; in electrical experiments the shock is single, and momentary; but earthquakes are felt for some few minutes.

To answer which, we need not urge; how fear and frights multiply, and magnify objects, and appearances. But suppose the vibrations of an earthquake last two minutes, there can be no comparison, between our little *apparatus* in experiments, and the stroke upon seven hills, whereon *Lisbon* is built. The vibrations of musical strings are in proportion to their length, and thickness: the same of bells, and the like. There is no comparison between the snap in our  
little

little experiments, and a shock upon the globe of the earth; whence the horrible noise rolling from one eminence to another: as in the air, the thunder is re-echoed from one cloud to another.

Again, some find difficulties from apertures in the earth, and sinkings into the sea, as is the case of the key at *Lisbon*; and the like. So as to mountains opening, and rivers of water gushing out. I profess these instances move me not in the least, to derive them from the bowels of the earth. The electrical stroke from the atmosphere must divide a key, and push it into the sea, or a street that stands on a cliff; as it divides rocks, cliffs, mountains; and tumbles them down, like as the above recited case of *Whitstone* cliff, *Yorkshire*.

In mountains we expect reservoirs of water, whence springs and fountains flow, by an inexplicable operation of nature. And why may not electricity push rocks, and small islands into the sea. Though probably several of these cases are reported only from relations, under a false notion of the cause.

Some may object, that if the earth was electrified on an earthquake, every person ought to feel it; as when touch'd in the electrical experiments. But we know, the persons in a room where such experiments are try'd, are not ne-



cessarily electrified. Yet we find in earthquakes in fact many affected, as if electrify'd, by sickness: And all kind of animals are fully sensible of it, and extremely disturbed.

Sometime, the case of *Herculaneum*, and such fancied accidents are quoted, as places sunk, by force of an earthquake. But this is an erroneous position. The city remains intire. It was not shaken in its last *catastrophe*, but buried in the *lava* poured upon it from mount *Vesuvius*. These and such like, are little objections, which it is not worth while, to be elaborate in answering; as having no foundation on principles of philosophy.

I May 1751, I received a letter from *Peterborough*, by order of the literary Society there, with an account of a woman at *Sutton* by *Wansford*, who had been quite deaf for two years last past, but was perfectly restored to her hearing, on Sunday 30 September preceding, being the day of the earthquake there. She found herself restored half an hour before the shock.

April 1751, we had an account from *Edenburgh*, of a person restored to the use of speech, from a resolution of the nerves, by electrifying. His name *Robert Mowbray*. These and many like cases confirm our reasoning.

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Though the power that produces these amazing struggles in the elements, be manifestly one, and the same, yet it admits of some difference in its action; not only as it may be more, or less forcible, of more or less extent, or as to the different object of its action, but likewise in its manner. And this points out some names of distinction, which are at least useful, in all parts of learning and philosophy.

1. We may therefore denominate one of these appearances, the *air-quake*. This shows itself only in the air, in a most horrible rumbling noise, like many cannon let off, echoing from one hill to another. It may be called terrestrial thunder. The earth feels not its force, or but slightly, or partially, here and there; must not be thought to be in a proper electric state, and therefore not fully susceptible of the shock. This is owing to a preceding rainy, moist season: which is always adverse to electricity.

A loud clap of thunder in the atmosphere, may be heard over a circle of 500 miles diameter. The same clap discharged at the surface of the earth the 1st of *August* last, was heard all over the counties of *Lincoln* and *Rutland*; and part of all the circumjacent counties. It arose to an earthquake, wherever the ground was in a proper

per disposition for it, more or less. They that can suppose this *phænomenon* to arise from underground, are not to be argued with.

2. A second kind we may call a *waterquake*; which exerts itself in the air, and water, as this on Nov. 1. with us; causing a most vehement agitation of that element, lifting it up, and throwing it down by pulses, tossing it over the banks of canals, whirling about ships, and boats, shaking, and dashing them one against another, stirring up the water from the very bottom: raising it from the bottom of Wells, and the like.

This appearance occurs in the middle of the ocean: on the land, here and there accompanied with real shocks of an earthquake, wherever the earth is in an electric state. This *phænomenon* must acknowledge the same aerial origin.

The water is a ready object of its force, both from its mobility, and from its solidity. It chuses to run up rivers, to any length: to run along the shores, as ready conductors. They that can fancy subterraneous boilings like a culinary fire, under all the canals, lakes, rivers, sea-shores, and the ocean, affected at the same time, over a quarter of the globe, especially in the vessels of water prepar'd for brewing, are not to be argued with.

We



We are to conceive, that the electric power falls furiously on the water, by reason of the extreme solidity of the component particles of that most wonderful fluid element : whose sole property it is, of all matter, to be absolutely incompressible. Hence it more readily attracts, and assists the vehemence of the elemental, electric fire. Hence it so readily falls on rocks, mountains, steel, solid buildings, metals, the bones, and joints of animals, and whatever is of most specific gravity.

This therefore causes a thump at the bottom of a ship in the sea, as if striking on ground ; this shakes, and quivers the masts, like an aspen leaf.

3. The third diversity, we call properly the *earthquake* : a *tremor* of the surface of the earth, accompanied with the two preceding, especially the first, the rumbling noise. These undulations are boundless, as to space, time, or violence ; as far as the earth is prepar'd to receive them. For if a musical string be not rightly stretcht, it has no tone. So a wire in electrical experiments never so far extended, receives the touch, through its whole length.

It cannot be hard to observe, that all considerations show the impossibility of a fire underground perpetrating these dire calamities of earthquakes. The like as to the agitation in  
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the waters, which was perceiv'd even in great vessels of water for brewing : and more, even in lead when in fusion, at that same instant of time, as I was credibly inform'd.

We must likewise affirm, that the fire, and smoak of vulcano's, is the effect of the electrical stroke, not the cause. The great noise is prelusive of the fire, that kindles their component sulphurs, at the very summit ; like a match of brimstone struck by a flint and steel ; Nor can there be any fire, low in the earth, where there is no conveyance of air, no more than in an exhausted receiver. And though fires are found in the bottom of coal-mines, and the like, where the air can descend ; yet we never hear of earthquakes caus'd by them.

4. A fourth kind, I hold to be what we vulgarly call a *waterspout*, which is seen both on the water, and on the land. 'Tis a partial exercise of the aerial power, that lifts up the water in the ocean, rivers, wells, canals. A single *vortex* or column, sometimes visible of a great height.

In the accounts from *Cadiz* and other places, the water is seen coming from the great ocean, like a mountain, and when at the shore covering the land : and many of these like columns or ridges 50 or 60 foot high, more or less, succeeding one another. The like appearance *cæteris paribus* in lakes, canals. All these are  
owing

twing to the same aerial power that makes the water-spouts.

All these four kinds proceed from the same cause, under some differing circumstances, single, or complex, greater or lesser. The *rationale* of them we leave to further disquisition, content to point out some of them, and enumerate their *species*.

I shall mention a pertinent observation of our friend the learned Dr. *Pocock*, archdeacon of *Dublin*; in his excellent description of *Egypt*, pag. 195.

“ It has hardly been known, says he, that  
“ they had any earthquakes which did mischief,  
“ in *Egypt*; and those that rarely happen’d  
“ were scarce perceivable. But in *January*  
“ 1740, they had three great shocks, immediately, one after another; which threw  
“ down some mosques, and several houses. It  
“ being a year of scarcity (therefore dry, from  
“ failure of the *Nile*) all the people prayed  
“ for plenty of corn. As they have a strange  
“ notion, that at such times, the Heavens are  
“ opened, and their prayers heard.”

Assuredly, this notion of the *Egyptians* may be accounted orthodox, as well as philosophical. They look upwards for the cause, as well as the use, to be made of these extraordinary movements, under our feet. Happy are we,

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if



if we think in the same manner. It may put us in mind of one circumstance, seen generally throughout all that we have hitherto spoke of. The chief instances of earthquakes are notoriously directed to cities, great and rich towns, places of traffick and concourse, that the numerous inhabitants may be induc'd seriously to take warning at such judgments, and apply to the Divine Being, *whose majesty is as his mercy.*

Is it not a manifest intimation of a supernatural hand, that directs these natural causes, these elemental convulsions ; and of infinite goodness ; when in the almost universal destruction of the city of *Sevil*, for instance, only four persons lost their lives.

To come home, how ought we to adore the good providence of God, who spar'd us of this island, in so wonderful a manner ! turning what we reckon'd a calamity, into the greatest blessing ; I mean the rainy season last winter, and spring, and summer, and autumn, and the present winter, which we may justly conclude, sav'd us from the hideous ruin of the more southern climates.

Even in the extreme *catastrophe* of *Lisbon*, where more than 40,000 persons are most miserably perish'd, about a score only of our countrymen are involv'd in the number. And the only buildings left standing, are the *English* and *Dutch* protestant chapels. I

I shall conclude this essay, with a piece of criticism reminded by a learned friend Mr. *Woolfe*. We have seen universally, that all these earthquakes and agitations happen in a serene sky. We have asserted their cause to be electrical strokes from the atmosphere, the same as thunder and lightning. Now, that thunder and lightning which produces earthquakes, is found in a clear sky, free from clouds, was known to that great genius *Horace*, as appears very fairly, from ode xxxiv. of first book; but not commonly understood, from want of a true pointing. Thus,

*Parcus deorum cultor & infrequens,  
Insanientis dum sapientiæ*

*Consultus erro; nunc retrorsum  
Vela dare, atque iterare cursus  
Cogor relictos. Namque Diespiter  
Igni corusco nubila dividens*

*Plerumque; per purum tonantes  
Egit equos, volucremque currum.  
Quo bruta tellus, & vaga flumina  
Quo Styx & invisi horrida Tænari  
Sedes, Atlanteusque finis  
Concutitur.*

A comma is usually put after the word *dividens* but erroneously. Mr. *Baxter* discerned, it ought to be after the word *plerumq*; otherwise

'tis

'tis not agreeable to that good sense we ought to find in our poet: and it now shows he was a philosopher too.

It may thus be translated, and too well accommodated to the present times.

Seldom do I observe the sacred day,  
And when at Temple, small devotion pay  
To the great Deity; but rather stand  
A hero in the unbelieving band;  
From terrors of a future judgment freed,  
To *Epicurus*, I refer my creed:  
But all in vain. For hitherto great *Jove*,  
Who o'er the clouds his thund'ring chariot  
drove;  
Of late his fiercest lightning has been seen  
To dart impetuous, thro' the sky serene.  
The solid earth an awful tremor feels,  
The rivers dance before his chariot wheels.  
To *Africk's* shores the rapid shock extends  
E'en to the dreadful *Stygian* cave descends.  
The yawning realm of *Tænarus* appears  
Awakens conscience with unusual fears.

Read at the Royal Society,  
January 15,  
1756.

W. Stukeley.



F I N I S.



